The Dock and Harbour Authority

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Editorial Comments

Sandusky: Great Lakes Coal Port.

From the needs and concerns of a fishery harbour on the Continent of Europe, we turn this month to those of a coaling port in the interior of the American Continent; the leading article in this issue deals with the handling on the Great Lakes of an essential commodity for industry and power generation. The particulars on which the article is based have been taken from the investigations and subsequent report of the United States Army Board of Engineers for Rivers and Harbours, published in their Lake Port series.

Located at the most southerly point of Lake Erie on Sandusky Bay, about midway between Toledo in the West and Cleveland in the East, the Port of Sandusky carries on a coal export trade which reaches between seven and eight million tons per annum, and is entirely confined to inland destinations in Canada and the United States.

Coal, both bituminous and anthracite, is, in fact, the staple trade of the port, though there is some slight mineral traffic in sand and gravel, as also in fish, grain and fruit.

Nearly all the ports on the shores of Lakes Michigan, Superior, Huron, Erie and Ontario are destinations to a greater or lesser extent for the coal exported through the group of ports on the south side of Lake Erie and the special nature of their trade is such as to have given rise to a particular type of bulk freighter, or carrier, which is practically a large single hold extending the entire length of the vessel. This and other special features of trade on the Great Lakes were described in an address by Lieut.-Colonel W. H. Holcombe, published in our issue of September, 1940, to which we draw the attention of our readers.

As regards the port appliances for dealing with these cargoes, our readers will perhaps recall that Col. Holcombe in the address in question said that the transfer was effected by means of a car-dumper which enabled coal cars of any capacity to be picked up, inverted, and emptied into a hopper, from which the coal falls through shoots into the hold of the vessel. The capacity of the dumpers ranges from twenty to fifty cars per hour.

We are confident that the particulars of the Port of Sandusky given in the article will be of interest to readers who are connected with the coal export trade. In addition to its water-borne trade and facilities, Sandusky has claims to notability as a fine city laid out with broad streets and up-to-date amenities. It is a leading municipality of the State of Ohio and the capital of Erie County.

Port of London; Master Plan for Sea-Air Port.

Plans and projects for the reconstruction and development of the Metropolis and Port of London follow thick and fast upon one another. Hardly had the report of the Royal Institute of British Architects appeared (dealt with in our last issue), than there followed on its heels a plan propounded by the London County Council covering the whole of the London area, and now in the *P.L.A. Monthly* for July is to be found a "Master Plan for a Sea-Air Port" prepared by Mr. F. G. Miles, relating more particularly to accommodation for planes engaged in sea and air transport.

It is difficult to comment adequately on this accumulation of designs and no doubt, before the war is over, a number of them will have been published and relegated to oblivion, though we do not suggest that this will happen in the present case. Among the various ideas put forth, some one will surely be found of utility for acceptance under post-war conditions.

We publish on a subsequent page, through the courtesy of the Port of London Authority, a bird's-eye view of Mr. Miles' project, the site and location of which are not clearly defined, though stated to have actual existence. The points in its favour are stated to be that it is level, that an existing system of dykes facilitates the draining of the entire area, that existing road and rail services form a link with London, which is only half-an-hour's journey by fast train, and that the river basin at this point is remarkably dog-free during the winter months. These and certain other indications point to a site at Cliffe on the North Coast of Kent.

The air-port has been planned solely as a base for land and sea planes and makes no provision for shipping. There is to be a lagoon, approximately oval in shape, which will be entirely enclosed, and this will enable flying boats to be serviced, loaded and unloaded as speedily as the land planes. As this is a feature which, though clearly bordering upon it, hardly comes strictly within the province of this Journal, we do not feel called upon to make any detailed observations at the moment, but it may be stated that the scheme, as shown on the plan, without allowing for main arterial road approach or railway construction, would cost approximately twenty millions sterling. It may be added that, if the interior lagoon is dispensed with and a small tidal basin substituted for sea-planes, the actual take-offs and landings being carried out on the estuary itself, four millions could be saved. The public are so accustomed these days to dealing with finance of "astronomical" proportions

Editorial Comments—continued

that we do not imagine this formidable figure will cause any sensation, but it certainly does postulate a great deal of consideration before deciding to embark on so ambitious a scheme under post-war conditions.

Quayside Cranes.

In the comprehensive series of articles on Quayside Cargo Handling Appliances which is being contributed to this Journal from the expert pen of Mr. J. Dalziel, a very exhaustive account is given of the quayside crane and its operative qualities. So thorough is the disquisition that the Author has not been able to complete it in the instalment in the present issue; it will be continued in succeeding issues, and we feel sure engineers responsible for the installation and maintenance of quayside appliances will be grateful to Mr. Dalziel, among other things, for his detailed and unbiased statement of the respective merits of hydraulic and electric cranes in regard to their suitability for cargo handling. In our opinion he has handled this debatable question with impartiality and skill, and we think that there will be general agreement with his conclusion as to the superiority of electric power for the rapidity of movement and adaptation to variation in load requisite in quayside cargo handling appliances. Only on one point do we feel that the position of the hydraulic crane has been left by the Author at a disadvantage, and that is in regard to the relative initial cost and durability of the two types.

When, some years ago, we had to deal fairly frequently with the question of quayside equipment, it was our experience that an electric crane cost anything up to 30% in excess of a hydraulic crane of equal capacity and outreach, and despite the changes brought about in recent times in the cost of production, we have reason to believe that this ratio still holds good with reasonable approximation. Moreover, the hydraulic crane, being of more substantial and less complicated construction, is generally characterised by a longer period of useful life; in fact, we have known hydraulic cranes to continue in active service for upwards of 40 years and this without any excessive expenditure on maintenance. The capital charges in the way of interest on outlay and on amortization are therefore by no means a negligible factor in an economic comparison of the two types, although, generally speaking, it may be conceded that this particular advantage will often be outweighed by other considerations.

As pointed out in the article, there is still a useful sphere for hydraulic appliances where uniform, slow lifts are concerned, of the full, or nearly full, capacity of the appliance, as in the heavier types of crane, and also as regards power in lock-gate machinery. But here we are entering a field distinct from that of cargo handling.

Pilferage at the Quayside.

That ugly misdemeanour commonly called Pilferage, but which would be better described in plain terms as Larceny or Theft, continues to manifest itself with painful persistency at the ports of this country. At a recent series of cases dealt with at Southampton Police Court, it was stated by the Deputy Town Clerk, who was prosecuting, that losses by theft from cargoes brought into this country average 2,500 lbs. (over a ton) on each ship. "Before the war," he added, "the loss on incoming cargo at all ports throughout the country was 1.4d. per ton; to-day, it is 26.9d. per ton—25 times as much."

In the House of Commons on July 1st, Mr. J. H. Wooten-Davies, member for Heywood and Radcliffe Division of Lancashire, asked the Parliamentary Secretary to the Ministry of War Transport if his attention had been called to the thefts from outward-bound cargoes, and what attempts were made to trace where these took place.

Mr. Noel Baker in reply said: "Yes, sir, I regret to say that thieving from cargoes, both inward and outward-bound, has increased since the beginning of the war. The black-out, shortage of packing materials, and shortage of man-power have all added to the difficulties of preventing such theft; but I can assure him that the Police, the Dock Authorities, and the railways are acting in close co-operation, and are doing everything in their power to trace and to stamp out, what must be regarded as a despicable sabotage of the national war effort."

The foregoing indicates a deplorable enough state of affairs, but it is further accentuated by the following warning which has been issued by Lord Leathers, the Minister of War Transport:

"My attention has recently been drawn to a most despicable type of thieving which has occurred on some ships. I mean thieving and stealing from lifeboats of stores and food, which are placed there in order that those, who have to abandon ship at sea, have a reasonable chance of reaching safety. This type of offence has been called pilferage by some people, but, to my mind, there is no more heinous type of thieving and stealing. I am accordingly taking steps to ensure that offences of this character are prosecuted with the utmost rigour of the law. I am advised that the Courts have power to inflict very heavy penalties for this type of offence, and I have little doubt that in proper cases severe penalties will be imposed.

"I hope that this warning may prevent any further dastardly offences of this character occurring, and that all those who have the welfare of our seamen at heart will do their utmost to assist the authorities."

What is the remedy for this desperate and insidious evil? Certainly not the present method of imposing a small or moderate fine. It is well known to the Police that a system prevails at ports by which the workmates of a convicted offender club together to pay the fine, and that there is a wholesale conspiracy on the part of the dockers to screen the practice of thieving, on which a large number of them appear to be engaged, and to defeat the ends of Justice.

These are times of national emergency and under present conditions, there is little, if any, difference between dockside thefts and looting from bombed premises. In the latter case, the statutory penalty is death or penal servitude for life. Why not, in the case of pilferage, make it, as has already been suggested, an offence punishable by imprisonment without the option of a fine? Something of a very drastic nature is required to put an end to a practice which is assuming alarming proportions.

Aberdeen Chamber of Commerce and Port Development.

For some time past there have been published in the local press statements exhibiting a somewhat acute controversy between the Aberdeen Chamber of Commerce and the Aberdeen Harbour Commissioners on the efficiency and future development of the Port of Aberdeen. An unfortunate misunderstanding, which apparently gave rise to the matter, has now been cleared up, and in a recent exchange of views the Chamber has indicated its satisfaction with the attitude which the Commissioners are adopting towards the need for improvements in and extensions of the harbour accommodation. The Harbour Commissioners have expressed their appreciation of the offer of the Chamber to co-operate with them in planning projected developments, as well as their acknowledgment of the past work of the Commissioners in the development of the port.

Tyne River Crossings.

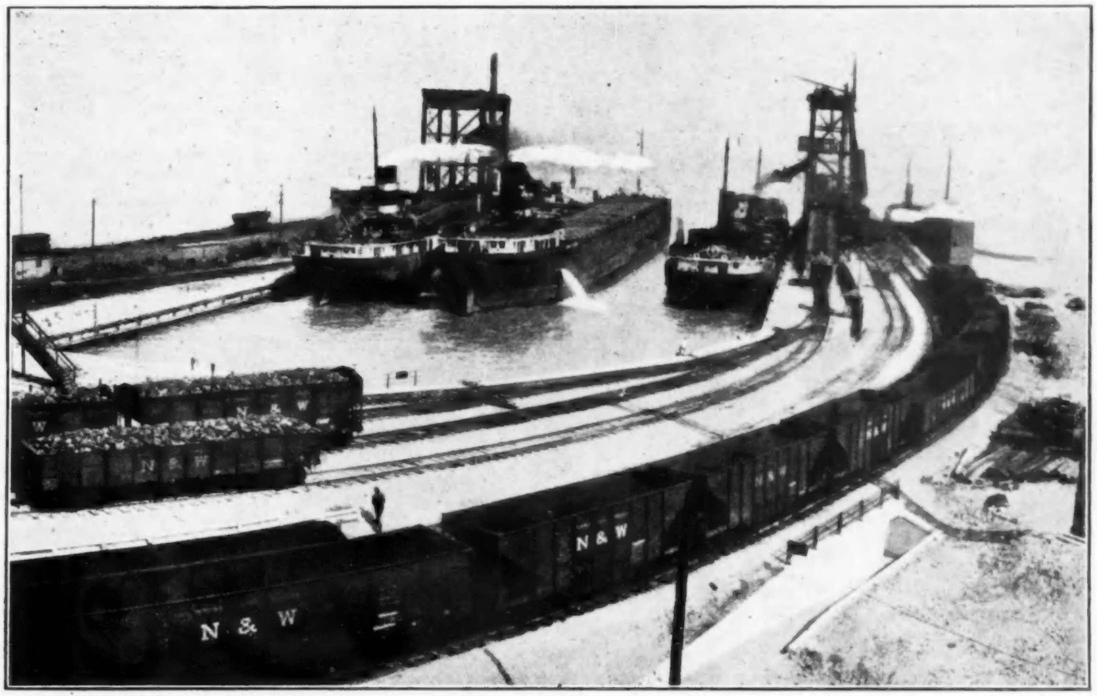
A question which is causing considerable discussion on Tyneside is the proposal for a tunnel beneath the river to link South Shields and Tynemouth. At present, a cross-river service is maintained by ferry steamers, operated by the Tyne Improvement Commission, who are anxious to be relieved of a transport service which is outside their primary responsibilities as a port and harbour authority, and which has hitherto been run at a loss. This loss at present falls on duespayers to the Commission and only very indirectly on the riverside boroughs, whose inhabitants reap the main benefit. The Commissioners have appealed to the Ministry of War Transport for relief from the burden.

The Ministry have made known that in their view, the ferries form part of a highway, and that they should be maintained by the two boroughs directly concerned, aided by a grant of 50 per cent. towards the capital cost of purchase and 50 per cent. towards maintenance, conditional on the ferries becoming free. The Tyne Commissioners have offered to sell the ferry installations at book value, but, so far, the boroughs have declined the offer.

On the occasion of a recent joint deputation from the two corporations concerned, the Parliamentary Secretary to the Ministry expressed the opinion that the case for a tunnel had been made out. Further negotiations are in progress.

The Port of Sandusky, Ohio, U.S.A.

*Pre-war Port and Harbour Conditions**



Pennsylvania Coal Docks, Sandusky, Ohio.

General Description

SANDUSKY is located in the south-easterly part of Sandusky Bay which opens into Lake Erie at its westerly end. By water the port is 55 miles westerly from Cleveland, Ohio, and 52 miles easterly from Toledo, Ohio.

In the following description of the channels in the port all depths are referred to the low-water datum of Lake Erie which has an elevation of 570.5-ft. above mean tide at New York. Ordinary fluctuations of water in the harbour are from 3-ft. above to low-water datum and extreme fluctuations are from 6-ft. above to 2.5-ft. below low-water datum.

The United States has improved and maintains an entrance channel from deep water in the lake through the sand bar at the mouth of the bay running south-westerly for approximately 1½ miles, thence the channel's course is southerly for approximately 2 miles to the city front channel. This entrance channel is 21-ft. deep and 400-ft. wide. The city front channel is 300-ft. wide and 22-ft. deep, and extends south-westerly along the docks for a distance of approximately 1½ miles, terminating in a turning basin 800-ft. by 1,000-ft. at the Pennsylvania Railroad coal dock. The United States has also built a rock dyke protecting the west half of the city front channel. This lies north of the channel and extends from a point opposite the west side of the Hinde & Dauch Paper Co. wharf to the channel dredged by the Pennsylvania Railroad alongside its new coal dock.

The Pennsylvania Railroad has dredged a channel from the turning basin along its dock for approximately 3,500-ft., 400-ft. wide and 22-ft. deep. Thence the channel is 300-ft. wide and 22-ft. deep and is parallel to and approximately 3,000-ft. from the city front channel for a distance of approximately 8,000-ft. to the entrance channel provided and maintained by the United States.

Improvements by local interests of the Sandusky Harbour area have consisted of excavating rock from the channel in front of the city within the limits of the existing Government project and the removal of three rock shoal areas from the turning basin at the westerly end of the channel. In addition to the above-mentioned improvement work, a total of $325,000 has been contributed toward the cost of the work done by the Federal Government.

Currents

Sandusky Bay is subject to severe current conditions brought about by the prevailing wind on the lake. The current is most marked at the opening of the New York Central Railroad bridge (outside the limits of deep-draft navigation) and at the piers at the end of Cedar Point. Moreover, the current tends to run heavier in the dredged channels than in the shallow areas. The maximum current in the channel is estimated at about 3 miles per hour. Local winds cause noticeable currents but the maximum effects come from the wind prevailing throughout the Lake Erie area. Should the prevailing wind be opposed to the local wind the current will run against the local wind. Spring freshets cause an outward running current, but it is not of sufficient strength to affect navigation adversely.

There is no anchorage area for deep-draft vessels available at Sandusky, Ohio.

Weather Conditions

Season of Navigation.—The dates of opening and closing of navigation are as follows:

	Opening	Closing
Earliest date	March 15th	December 1st
Latest date	April 14th	December 24th
Average date	March 28th	December 8th

*Extracts from Lake Series No. 8, prepared by United States Board of Engineers for Rivers and Harbours, War Department, Washington, U.S.A.

Port of Sandusky, Ohio—continued

Prevailing Winds.—The prevailing wind is south-west for the entire 12 months.

Ice.—The closing and opening of navigation is governed by ice conditions in Lake Erie. Ice generally begins to form in December and breaks up and moves eastward in March. However, the exact dates vary greatly, depending upon weather conditions.

Fogs.—Reports for 47 years show that during 8 months of the year, March to October, inclusive, there has been less than 1 day of dense fog per month. During the remaining 4 months there has been an average of 1 day of dense fog per month.

Public Terminal Improvements

The City of Sandusky owns a small pier at the foot of Jefferson Street which is used as a public landing for small freighters and recreational craft and for parking automobiles. The city has also constructed a sheltered small-boat harbour at Battery Park near the easterly end of the dock channel, which can accommodate a large number of pleasure craft of 7-ft. draft or less.

Ownership of Water Front.

The total water frontage at the port is about 41,000-ft. The ownership and development of this frontage is shown in the following table:

Owned by	Total lineal feet	Developed lineal feet
State of Ohio	200	200
City of Sandusky	3,434	3,201
Railroads	11,919	3,660
Industries	5,017	5,017
Steamship companies	99	99
Private owners	20,236	1,770

Port Administration and Local Regulations

There is no port administrative body, either State or municipal.

In conformity with Section 7 of the River and Harbour Act of August 8th, 1917, the following regulations were approved by the Secretary of War on May 6th, 1938.

1. No vessel shall exceed a speed of 10 miles per hour in Sandusky Harbour.

2. No vessel shall cross the edges of the channel without reducing its speed sufficiently to avoid displacement of said edges. Vessels crossing said channel shall keep out of the way of vessels navigating the channel.

3. No vessel shall, while moored or at anchor, or by slow passage or otherwise while under way, unreasonably obstruct the free passage and progress of other vessels.

4. No vessel shall moor or anchor to any structure of the United States without the consent of the District Engineer, United States Army, in charge of the locality, or his authorised agent.

5. No vessel shall moor or anchor in or along any improved channel or basin in such manner as to interfere with improvement or maintenance operations therein. Whenever in the opinion of the District Engineer any vessel is so moored or anchored, the owner thereof shall cause said vessel to be moved upon notification from and within the time specified by said District Engineer.

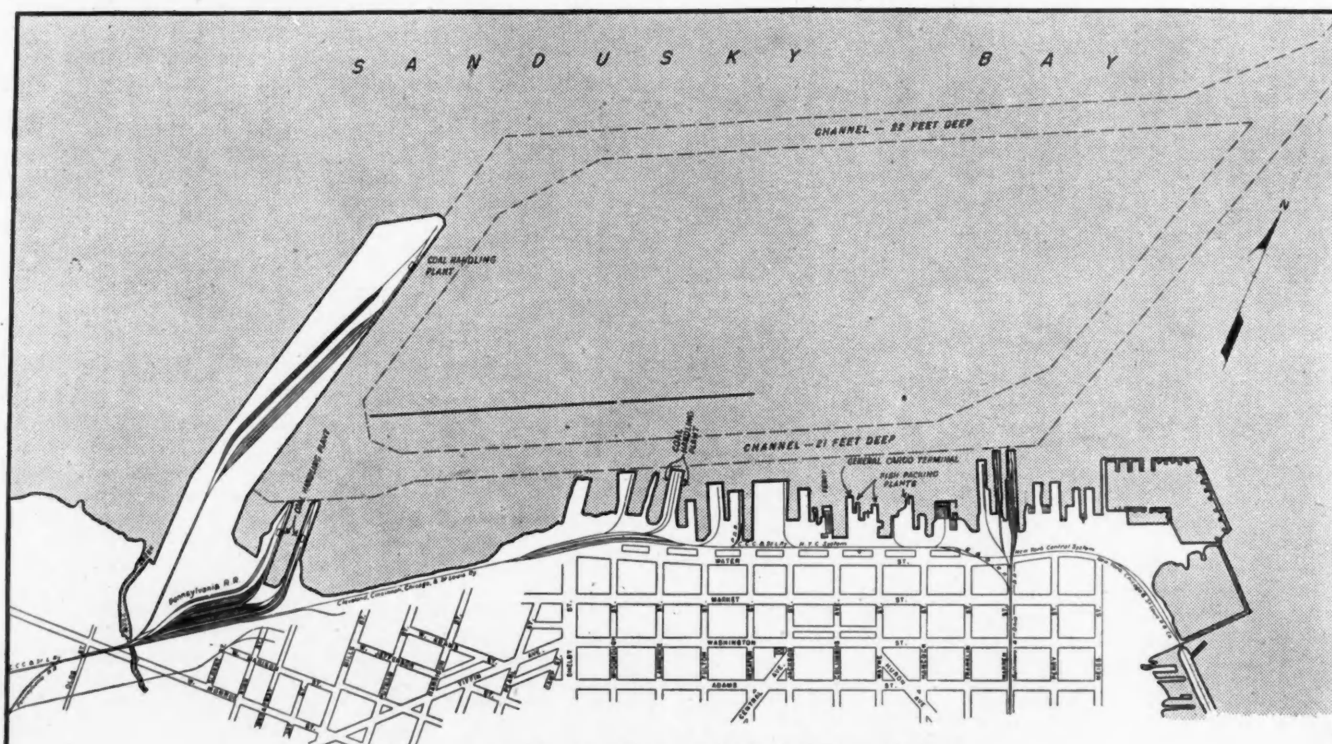
6. These regulations shall take effect and be in force on and after the date of approval hereof and shall supersede the regulations prescribed January 6th, 1899, as amended September 29th, 1899, and June 10th, 1920.

Pilotage

Pilotage is not compulsory at the Port of Sandusky. All masters of Great Lakes vessels pilot their ships to their destinations. Generally, tugboats assist vessels to navigate in the harbour.

Towage

Towage service is ample and readily available. The use of tugs is not obligatory, but due to the confined manœuvring area and the large bulk-freight type vessels using the port, it is advisable and sometimes necessary to employ a tug.



PORT OF SANDUSKY, OHIO.

PREPARED FROM A PLAN ISSUED BY THE UNITED STATES ARMY BOARD OF ENGINEERS FOR RIVERS & HARBOURS

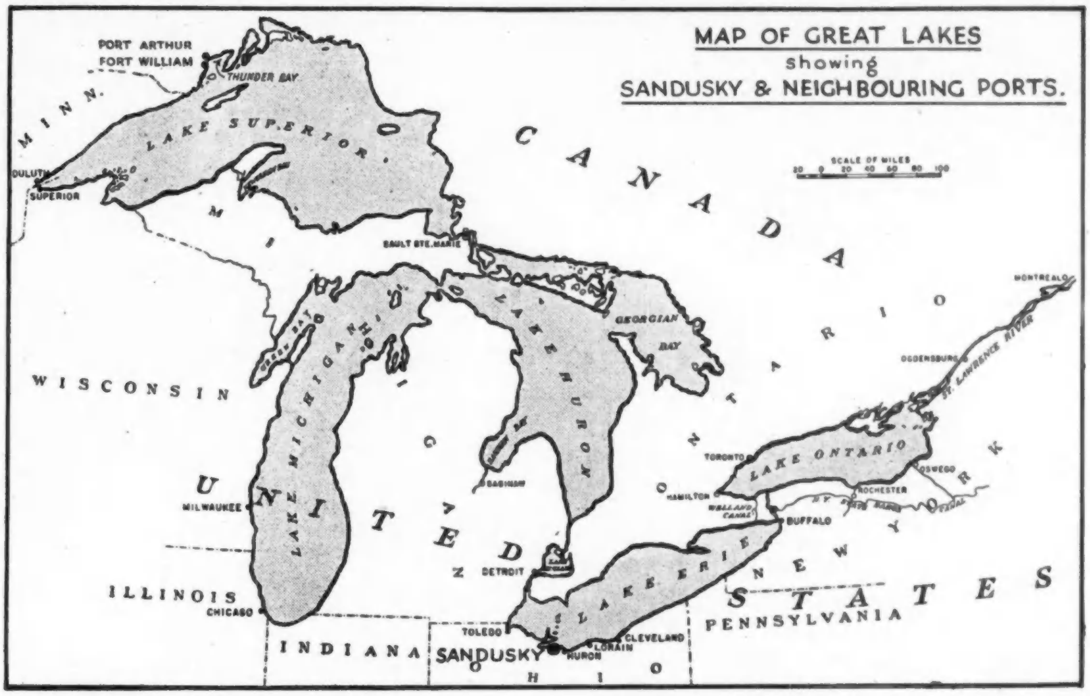
SCALE OF FEET

500 0 500 1000 1500 2000

Port of Sandusky, Ohio—continued

Dockage, Wharfage and Lighterage

No dockage is charged against vessels loading or discharging cargo. No wharfage charges are assessed, as the docks are operated chiefly for the receipt or shipment of bulk commodities or in connection with the business of their owners. Lighterage is not required at this port, as the slips have been dredged to permit vessels to berth alongside the docks.



Loading and Discharging Vessels

Coal is loaded to vessels by means of steam and electric car dumpers. At Lower Lakes Dock No. 3, the new dock of the Pennsylvania Railroad, there is a fixed dumper with a maximum lift of 120 tons and a reach of 50-ft., by means of which vessels can be loaded at the rate of 60 to 70 cars per hour. At Lower Lakes Docks Nos. 1 and 2 there are car dumpers by means of which 45 cars of coal can be loaded to vessels per hour at each dock, one of which has a lift capacity of 120 tons and the other 100 tons. Sand is unloaded by means of the self-unloading equipment on the vessels or by steam cranes. Two steam cranes are available for this purpose, each of which is equipped with a 2-yard clamshell bucket, one having a capacity of 35 tons per hour and the other a capacity of 100 tons per hour. Certain other mechanical handling facilities are available for use. No special equipment has been provided for handling general merchandise or package freight.

Port and Harbour Facilities

There are 29 piers, wharves and docks at the Port of Sandusky, five of which are used for the shipment or bunkering of coal, three for the receipt of sand, stone or gravel, seven in connection with the fishing industry, two as passenger and package freight landings, four for club or other recreational purposes, and one as a tie-up for barges. One dock is owned by the city and is used as a public landing for small freighters and recreational craft and for parking automobiles. The remaining six facilities are not used by vessels.

The Pennsylvania Railroad owns three wharves at the foot of King Street which are operated as coal-loading and coal-bunkering terminals by the Lower Lake Dock Co. The Kelley Island Lime and Transport Co. leases two wharves for the handling of sand, gravel and other bulk cargoes. A passenger-boat terminal is maintained by the Sandusky and Island Steamboat Co., which operates between Sandusky and the nearby islands in Lake Erie. The G. A. Boeckling Co. provides a terminal for its passenger and package-freight ferries which ply between Sandusky and Cedar Point, Ohio. The Hunt Coal Co. and the Misch Coal Co. share one dock at the foot of Lawrence Street. The Hunt Coal Co. stores and supplies coal for the retail trade, bunkers small boats and acts as agent for the Ashley and Dustin Steamship Line, which uses this dock as a terminal. The Ashley and Dustin Steamship Line operates passenger service from Detroit to Put in Bay, Cedar Point, and Sandusky. The Misch Coal Co. is also engaged in the retail coal business and maintains stores on its dock from which bunker coal is supplied to small steamers and to the tow boat of the Great Lakes Towing Co., which maintains a berth and call station at the outer end of the dock. The office of the coal company is located at Market and Pearl Streets. The Wagner Quarries Co. dock at the foot of Warren Street is used for the shipment of stone, which is moved by rail from their quarries near the city to the dock.

The city of Sandusky maintains fire hydrants in the vicinity of the docks for protection of the water-front facilities. There is no floating fire-fighting equipment, but the municipal fire department and local tugs would render assistance in case of emergency.

Bridge Crane unloading Coal at Great Lakes Port.

Port of Sandusky, Ohio—continued

Railroads

The Port of Sandusky is reached by the rails of five important railroad systems, as follows: Baltimore and Ohio Railroad, Cleveland, Cincinnati, Chicago and St. Louis Railway (New York Central R. R., lessee), New York Central Railroad, New York, Chicago and St. Louis Railroad, and the Pennsylvania Railroad.

Commerce

The water-borne commerce of the Port of Sandusky consists chiefly of movements on the Great Lakes, there being only occasional movements to or from overseas ports and no coastwise traffic. The following table shows the foreign and domestic traffic at the port annually since 1920:

	Foreign Short tons	Domestic Short tons	Total Short tons
1921	503,354	1,923,866	2,427,220
1922	341,001	3,155,623	3,496,624
1923	580,666	3,316,082	3,896,748
1924	773,692	4,038,812	4,812,504
1925	1,392,633	5,322,019	6,714,652
1926	1,415,016	6,245,644	7,660,660
1927	1,371,565	7,204,816	8,576,381
1828	1,262,766	6,348,512	7,611,278
1929	1,377,271	8,720,242	10,097,513
1930	1,137,780	7,141,929	8,279,709
1931	885,300	5,822,087	6,707,387
1932	486,784	4,289,921	4,776,705
1933	775,792	5,406,547	6,182,339
1934	583,876	5,757,631	6,341,507
1935	459,324	6,246,082	6,705,406
1936	674,749	9,069,162	9,743,911
1937	671,234	7,431,538	8,102,772
1938	1,150,226	6,756,383	7,906,609

Sandusky is primarily a coal shipping port. The coal is mined in Pennsylvania, Virginia, West Virginia, and Kentucky, and shipped to Sandusky by rail where it is transferred to lake vessels for movement to United States and Canadian lake ports. From the statistics of traffic for the 10-year period 1929-38, it is found that coal shipments during the period, including bunker coal and anthracite, as well as bituminous cargo coal, averaged 7,118,789 tons per year compared with a total traffic averaging 7,484,392 tons per year. Crushed stone and sand were also important items of traffic during this period.

Imports.—During the 10-year period for which detailed statistics have been examined, the import traffic from Canada averaged 60,260 tons per year. The tonnage received from Canada in 1938, however, was more than double that imported during the other 9 years of the period combined, since it included 434,203 tons of sand for use in the construction of the new coal dock of the Pennsylvania Railroad. During the calendar year 1932 there were 61,413 tons of potash imported from overseas, this being the only year in which there were any overseas imports or any imports of potash. Averaged over the 10-year period, however, potash accounted for 10.4 per cent. of the imports from Canada and overseas combined.

Exports.—There were no exports to overseas points from Sandusky during the period under discussion. Exports to Canada comprised 10.1 per cent. of the total port traffic, the average annual movement being 753,832 short tons. Bituminous and bunker coal together comprised 99.9 per cent of the exports. In addition, there was an average movement of approximately 100 tons of anthracite.

Lakewise Receipts.—Less than .1 per cent. of the total traffic handled at Sandusky was received from other ports on the Great Lakes, the average movement of lakewise receipts being only 5,627 short tons per annum. Stone, sulphur, and sodium nitrate together comprised 51 per cent. of the lakewise receipts. It should be noted that the movements of these commodities were irregular, stone having been received in only two years, sulphur in four years, and sodium nitrate in only one year. In 1938, 4,982 tons of fuel oil were received, this being the only movement of this commodity during the period.

Lakewise Shipments.—It has already been stated that Sandusky is noted as a coal shipping port. Bituminous coal has been shipped from Sandusky to other United States ports on the Lakes in an average amount of 6,237,335 short tons per year, and an average of 127,220 tons of coal was loaded on vessels for bunker purposes during the period under discussion. The two tonnages combined accounted for 97.5 per cent. of the total outbound lakewise traffic. In addition, there was an average movement of 956 tons of anthracite per year. Stone comprised 2.2 per cent. of the lakewise shipments with an annual traffic of 141,448 tons.

Local Traffic.—Local traffic, that is traffic within the confines of the port or from or to the adjacent waters, averaged 130,797 short tons per year during the 10-year period. This traffic consisted chiefly of lake sand, with smaller quantities of limestone, fresh fish, coal, canned goods, and fruits and vegetables. During the calendar year 1938 such local traffic totalled 186,301 short tons. Of this tonnage, 3,020 tons of fresh fish and 73,350 tons of sand were taken from Lake Erie and 109,931 tons were handled within the port area. Of the latter tonnage, 83,850 tons of limestone, 13,000 tons of concrete aggregate, and 11,265 tons of sand were used in connection with wharf construction.

Dock Fire Danger

(COMMUNICATED)

Dock and harbour interests, and the shipping world generally, have a particular interest in the Fire Wastage Campaign, which has just been launched and in connection with which Miss Ellen Wilkinson, M.P., Parliamentary Secretary to the Minister of Home Security, recently made a speech urging wives " to nag their husbands " to be careful over pipes, cigarettes and matches in the home

Surveys of fire-incidence already made, have established that there are certain special danger points in the fabric of national war production. War factories, farms, docks, and ports—all these offer particularly acute risks. Most important of all, probably, are the latter because in and around them inevitably are assembled great stocks of raw materials and finished goods, awaiting distribution. Now that the financial loss, grave as it is, is secondary to the irreplaceable loss of the materials of war and of necessities for the Home Front, the danger of fire damage at docks and ports is more acute than it ever was. The need for intensified vigilance is correspondingly urgent.

The main cause of the non-enemy fires which reach the terrible total of 365,000 a year in this country, is one to which dock and harbour installations are particularly vulnerable. That cause is the dropped cigarette-end and the smouldering match. It is responsible for more than 50 per cent. of all outbreaks. Nowhere could it be more menacing than among a cargo of paper, tobacco, wood or grain, indeed among any of the shiploads of goods which to-day, as never before, are indeed " lives of men."

Proposed Clyde-Forth Canal.

On the 14th July, a discussion took place in the House of Lords at the instance of Lord Teviot, respecting the proposed construction of a 30-mile ship canal between the Firth of Clyde and the Firth of Forth. He represented that, in his view, the canal would bring new industries to its banks and provide employment in the difficult times after the war. Also in war-time it could be used for repairing battleships away from the vulnerability of the East Coast.

The Duke of Montrose said that, in his opinion, the cost would be prohibitive. He pointed out that in 1919, it was estimated that the cost would be at least £826,000 per constructional mile. It would be the most costly canal in the world, apart from the Panama Canal.

Lord Leathers, Minister of War Transport, said that there could be no question of undertaking the construction of such a canal now, nor could he hold out any hope that it could be undertaken in the immediate post-war years. He would not rule out the possibility although, however, but stated that he had set up a small group to review the matter impartially and to make a confidential report to him.

At a meeting on July 20th, Scottish Unionist M.P.'s decided to continue the campaign for the project.

The Board Room of the Mersey Docks and Harbour Board

With Members in Session

Following the photograph of the Port of London Authority Board Room which appeared in our June issue, we have now the pleasure of exhibiting a similar picture of the Board Room of the Mersey Docks and Harbour Board, to whom we are indebted for the photograph.

The following is a list of the members present on the occasion. The central figure on the raised dais is the chairman of the Board, Sir Thomas A. L. Brocklebank, Bart. Immediately to *his* left, are Mr. R. J. Hodges (general manager and secretary) and Mr. R. D. Jackson (assistant secretary). On the chairman's right are Mr. R. H. Bransbury (solicitor) and Mr. L. Leighton (engineer-in-chief).

Seated round the horse-shoe shaped table are the following members, commencing at the right-hand side of the photograph, immediately below the framed portrait of the late Mr. Robert Gladstone (a former chairman) and proceeding clockwise: Sir W. Nicholas Cayzer, Bart.; Colonel J. G. B. Beazley, M.C., T.D.; Messrs. R. H. Thornton, M.C.; R. L. Holt; J. B. Watson Hughes; T. Stone; R. J. Hall; Alma Parkin; J. H. Coney; Hugh L. Roxburgh; W. M. Love, O.B.E.; E. G. Brownbill; Wm. M. Clarke; M. Arnet Robinson; R. M. Easton; W. B. Bibby; Lt.-Col. Albert Buckley, D.S.O.; Edmund Gardner (deputy chairman) and Charles McVey.

The following particulars of the Board Room have been kindly supplied. The Board Room is 45-ft. long by 40-ft. wide, and is panelled in Spanish mahogany. The Ionic columns are arranged in pairs and the domed ceiling is decorated in ornamental plaster. The seating consists of a dais on which the chairman and principal officials sit and a horse-shoe table is built in four sections for the accommodation of the members.

There is natural lighting on two sides of the room and the floor has been constructed in oak blocks with inlet mahogany surrounds. There is a large marble fireplace at the west end of the room faced with an ornamental centre panel and sides. Imprinted on the panel are the names of the sitting and past chairmen of the Board. On the walls are portraits of four past chairmen, viz.: Sir R. D. Holt, Bart (on left-hand side) and Robert Gladstone, Esq., Sir Helenus R. Robertson and Thomas Rome, Esq., on the right-hand side.

The Board's offices occupy a commanding position on the river frontage, the site being a portion of the old George's Dock close to the Pier Head. The aspect is due west.

The chief feature of the interior is the central octagonal hall, 72-ft. in diameter, and rising internally to a height of 120-ft., with a grand staircase and galleries at each floor level. Corridors radiating from these galleries provide access to all parts of the building.

The Board Room of the Mersey Docks and Harbour Board.

The grand staircase is constructed of grey granite from the quarries, formerly belonging to the Dock Board at Creetown, Dumfresshire, and the balustrade round the site is also built of the same material.

The halls and corridors on the ground floor are lined with white (Calacata) marble to a height of 8-ft. 6-in., the corridors on the upper floors having dadoes of white marble.

The central hall is surmounted externally by a dome rising to a height of 220-ft. above the pavement. The main entrance, situated in the centre of the river frontage, is flanked by two stone statues representing "Commerce" and "Industry." The extreme dimensions of the building are 264-ft. by 216-ft., and from pavement to main cornice the height is 80-ft.

The designs throughout have been arranged with thought, imbued with the maritime nature of the business for which the building was erected.

The architects were Messrs. Briggs & Wolstenholme, F. B. Hobbs and Arnold Thornely; Messrs. Brown & Sons, Manchester, being the contractors.

Review

Materials Handling: Principles, Equipment and Methods, by Harry E. Stocker. Pp. 309. With diagrams and numerous illustrations. Price: 5 dollars; New York, 1943, Prentice-Hall, Inc.

Based on his 15 years' experience as consultant and lecturer on the subject, the author, who is actively associated with a transport advisory concern and Assistant Professor of Transportation at New York University, has prepared a description and explanation of the fundamental principles, equipment and methods involved in the economical handling of commodities other than those handled in bulk. His exposition is very full and complete, and will be welcomed as a valuable source of reference by all who are engaged in this sphere of labour.

The scope of the book is not limited to quayside work, though it is very largely, and even predominantly, based on operations in connection with the shipment and discharge of cargoes.

Apart from an Introduction explanatory of the term "Materials Handling," there are eighteen chapters, divided into two main parts or divisions, the first dealing with the principles of materials handling and the second, with equipment and methods. The principles enunciated are the Terminal-Time, the Handling and Mechanical Equipment, the Performance, the Standardisation, the Obsolescence, the Flexibility and Speed, the Dead-weight, the Safety and the Straight Line and Fatigue—all of which are treated at length with abundance of example and illustration. The second division includes descriptive notices of Fork Trucks and Pallets, Tractors and Trailers, Conveyors and Cranes, Hand Trucks, Lift Trucks and Skids and Storage Racks. Consideration is given to the selection of types of equipment with details of specific cases. There are also observations on the designs of the various kinds of appliances, and on plant organisation. A useful series of appendices contains data on weights, measures, cubic contents and various properties of materials and specifications for equipment.

The book is amply, and even profusely, illustrated. The only adverse comment we have to make is that a number of the illustrations are somewhat indistinct and blurred probably through over-printing, making it difficult to discern details, though the outlines are fairly clear.

Naturally, the work is written from an American point of view. This is particularly evident in the section dealing with the quay crane, in which the writer shows some bias in favour of ship's gear with or without the cargo mast, which is a common feature at American ports. Opinions may well differ in regard to the relative advantages of the two systems of unloading, but we feel that Professor Stocker hardly does justice to the quay crane by simply stating a single argument in its favour, which he discounts immediately. He asserts that the more extensive area of deposit afforded by the use of a crane "would be of value if the cargo in a sling load were re-handled at ship's side." Unfortunately, there are circumstances under which this is unavoidably necessary. Storage of freight on board is often performed in a somewhat haphazard manner, owing to the great variety of goods for shipment, and the fact that a ship may call at a number of intermediate ports for additions to her freights. Since the various commodities are brought out of the ship's hold in no particular sequence, it often happens that sorting has to be done in a narrow space at the quayside, so that the advantage of the quay-crane's wider reach is very real indeed. This, at any rate, is the experience at a number of British ports. The Author's references also to the luffing action of quay cranes are very brief and casual. He makes no mention of level luffing, which is a very important feature of such cranes, as is evidenced by the greater number of special types which are to be found in operation at British ports.

Naturally, between the British and American points of view, there is much scope for discussion, not to say controversy, and English readers will find in Professor Stocker's book a good deal to interest them and to afford them material for profitable consideration.

American Association of Port Authorities.

It is announced that New Orleans has been selected for the meeting in October—19th to 22nd—this year of the annual Convention of the American Association of Port Authorities.

Publications Received

The **Journal of the Engineering Society of University College, London,** for the year 1942/3, bears witness to the continued and undiminished vitality of the Engineering Department of University College. It contains an address delivered at Gower Street by Professor R. O. Kapp on March 2nd last, in which he discussed the amplified scope of the activities of the various professional Institutions (such as the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Electrical Engineers, etc.). Expanding from their original purpose of promoting discussions and publishing papers, they have now embarked in various directions on the definition of terms and the drawing up of regulations to govern professional practice. This has involved co-ordination and collaboration with other similar bodies, outside this country and this, in Professor Kapp's opinion is a step of no small political value.

Two other papers of interest are the contributions of Mr. Quartermaine, Chief Engineer of the Great Western Railway and of Mr. Dunsheath, a Vice-President of the Institute of Electrical Engineers on the future of the war-time engineering student. These, with other contributions, make the number one well worth careful perusal and consideration.

The announcement is made that Dr. David Randall Pye, lately Director of Scientific Research at the Ministry of Air Production, has been appointed Provost of the College in place of the late Sir Allen Mawer.

The Institute of Mechanical Engineers have issued a Paper on **"A Renaissance of Mechanical Properties,"** by Squadron-Leader A. C. Vivian in which the author deplores the loose conceptions and unsystematic terminology of technical science at the present day. He advocates the adoption of a precise terminology, and learning to handle it is an unequivocal way, so that adequate visualisation would follow and thinking and feeling would then be in line with perfectly practical tests.

Retirement of Port of London River Superintendent

Captain E. C. Shankland, R.D., R.N.R., River Superintendent and Chief Harbour Master in the Port of London, retires from the staff of the Port of London Authority on the 1st August after a service of 21 years.

He served his apprenticeship and cadetship in sailing vessels, subsequently becoming an officer in the Clan Line and in submarine telegraph vessels operating from London. From October, 1909, to February, 1911, he underwent naval training in H.M. Fleet and from the latter date to April, 1913, served on the Newfoundland Survey in the Hydrographic Department of the Admiralty. From August, 1914, to March, 1915, he served with the Chatham Mine Laying Squadron in the North Sea and Thames Estuary. At the latter date, he was lent to the Mersey Docks and Harbour Board as an Assistant Marine Surveyor for survey duties in Liverpaal and approaches, becoming Senior Officer in May, 1916, until February, 1922, when he entered the service of the Port of London Authority.

As River Superintendent and Chief Harbour Master in the Port of London he has been concerned with a multitude of conservancy details, regulations and problems. He undertook a complete examination of the tidal and estuarial regimen of the Thames, which was embodied in a Paper prepared for the XVIIth Congress of the International Association of Navigation Congresses intended to have been held in Berlin in 1940, but concelled owing to the war.

He is the author of several works, notably "Modern Harbours: Conservancy and Operation" (1926), "Dredging of Harbours and Rivers" (1931) and "How Ships Find Their Way" (1943).

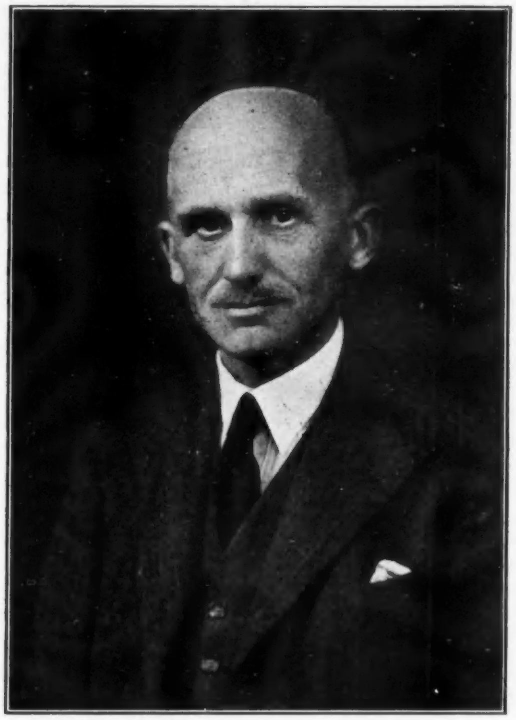
Captain Shankland has been a Member of the Honourable Company of Master Mariners from its inception in 1926 and became Prime Warden. He was mobilised for part-time service with the Navy on the outbreak of the present war, and was recalled for full-time service some months ago.

Captain Arthur M. Coleman, O.B.E., D.S.C., R.N., has been appointed by the Port of London Authority, Acting River Superintendent and Chief Harbour Master in succession to Captain Shankland.

Notable Port Personalities

XXXVII—Alderman A. Whitfield Stone Burgess, J.P.

Alderman Albert Whitfield Stone Burgess, J.P., Chairman of the Port of Bristol Authority, was born in 1884, at Bristol in the municipal affairs of which he has taken a prominent part. First elected as a Member of the City Council in 1919, he was, in 1922, appointed a member of the Port Authority and has, with the exception of a short period, continuously served the interests of the Port Authority during a time of great expansion and activity.



Alderman A. W. S. BURGESS, J.P.

His wide knowledge of the affairs of the Port and of the City and his ability to co-ordinate various points of view admirably equip him for the Chairmanship of the Port Authority to which position he was elected in 1937. In the meantime he had been elected an Alderman of the City in 1929 and made a Justice of the Peace in 1934. In the first year of the war, he was elected Lord Mayor of Bristol, and earned the great regard of the citizens during those difficult days.

Alderman Burgess has a wide range of interests in addition to port and civic affairs, and has been a member of the Council of Bristol University since 1936. He is a Vice-President of the Dock and Harbour Authorities' Association, a member of the Council of the Bristol Chamber of Commerce and of the Executive Committee of the Port Employers' Association. He is also a member of the South-west Regional Canal Committee.

Another Mobile Kitchen for London Dockers.

A mobile kitchen has been presented by the Women's Canadian Club of St. John, New Brunswick, to the Port of London Authority, for use at the London Docks. It is the third gift of the kind from Canada and the presentation was made on July 7th by Mrs. Vincent Massey, wife of the High Commissioner for Canada. The gift was acknowledged by the Rt. Hon. Thomas Wiles, chairman of the Port of London Authority, who said that it, with its predecessors, symbolised the innumerable unbreakable threads which bound the Empire together at probably the most crucial moment in the world's history.

The Grand Union Canal Company

Increase of Powers

The following communication has been received for publication:

The passing of the Grand Union Canal Bill, 1943, marks a new stage in the history of British Canals and the successful termination for the Grand Union Canal Company of a five years' war with British Shipping Companies. The Bill is a private Bill which in effect codifies and modernises the administrative and financial provisions of the various Special Acts governing the Grand Union Canal Company, the well-known canal undertaking. The Bill also confers various new powers upon the Company, the most important of these being the power to finance any company connected with the warehousing of goods or the transport of goods by sea, air or land, if the business of such company is likely directly or indirectly to increase traffic on the Company's canals. The Bill, as introduced into Parliament, contained a limitation of £75,000 in the amount which the Company could invest in shipping undertakings. This limitation had been previously agreed by the Company with the Port of London Authority, who were interested because the Regents Canal Dock of the Company is situate within the Port of London.

The story behind the Bill goes back to 1937, when the Board of the Canal Company was reconstituted after several years of declining revenue, and the Company embarked on a new policy of abandoning its role of being a mere toll-taker and transformed itself into a live transport organisation, offering the same facilities for traders as the railways. One of the features of the new policy was the institution of an all-water route service from the interior of the continent to Birmingham, goods being conveyed on continental canals to Belgian ports and from these by the Company's own shipping service, the Regents Line, to the Company's Regents Canal Dock and from there by canal to Birmingham, etc. Goods were also conveyed by means of the Oranje Shipping Line by an all-water route from Chicago and other American and Canadian lake ports to the Regents Canal Dock and thence by canal to Birmingham. Early in 1939 after the service had been running for a little over eighteen months, a writ was served on the Company by the Attorney General at the relation of rival shipping companies claiming that the action of the Company in running the shipping service was *ultra vires*. The action proceeded until shortly after the outbreak of war when it was suspended by mutual consent.

When the Company introduced the Bill into the House of Lords the Chamber of Shipping of the United Kingdom lodged a petition against it, despite the £75,000 limit to the Company's shipping investment powers. The principal ground of the opposition was that it was contrary to the public interest for canal companies to be given powers to invest in shipping companies. The Petition wa sheard by a Select Committee under the Chairmanship of Lord Kenilworth, and after a three days' hearing the clause was allowed in full. When the Bill reached the House of Commons, the Chamber of Shipping lodged another Petition against it on similar grounds and after a three days' hearing before a Select Committee under the Chairmanship of Sir Alexander Russell, the Bill was again passed without amendment, except a drafting amendment offered by the Company.

The passing of the Bill, which will virtually put an end to the pending action and gives wide new powers to the Company, is a personal triumph for the Chairman of the Company, Mr. John Miller. He was the chief witness for the Company before both Select Committees and as Chairman of the Executive Committee of the Board of Directors since 1937 he had been mainly responsible for the Company new policy.

The passing of the Bill also marks, a new stage in the history of British canals, as this will be the first occasion on which a canal company has been granted by Parliament clear and unambiguous power to take an interest in all forms of transport whether by land, sea or air.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this Journal should not be taken as an indication that they are necessarily available for export.

Notes of the Month

Dockers Strike at Fleetwood.

In the early days of July a strike of 300 dockers at the Port of Fleetwood caused a stoppage of work so that the discharge of fish from trawlers had to be carried out by troops.

Presentation to Dry Dock Foreman.

On his retirement after 41½ years continuous service with the Mercantile Dry Dock Company, of Jarrow-on-Tyne, Mr. William Lascelles, head foreman iron man has been the recipient of a wallet of Treasury notes and other gifts.

The Institute of Transport.

Mr. R. P. Biddle, Docks and Marine Manager, Southern Railway, at present on National Service at the Ministry of War Transport, has been elected a member of the Council of the Institute of Transport for the year commencing October 1st next.

Institute of Transport Examination Scheme.

The Examinations Committee of the Institute of Transport has decided that it will not be practicable for the intended changes in the subjects of the examination scheme to come into operation on October 1st, 1943, and it announces that, subject to the approval of the Council, the changes will not come into effect until October 1st, 1944.

Association of Consulting Engineers.

The Report of the Committee of the Association of Consulting Engineers for the twelve months ended 30th April, 1943, shows that the membership roll stands at 180, the highest in its history, 12 more than last year. The resignation of Mr. Ronald J. Harvey, who for six years has filled the office of Joint Hon. Secretary, has been marked by the presentation of an antique silver cup, subscribed for by members of the Association.

Development of Port of Los Angeles.

As a preliminary to extensive development of the Port of Los Angeles, California, U.S.A., the Harbour Commission of the Port has effected the purchase of 35 acres of water front property from the Southern Pacific Railroad. The property has a main channel frontage of 685-ft. and comprises piers, wharves, sheds and other installations made by the railroad company during a period of 30 years.

Proposed New Orleans Ship Channel.

The proposal for a 40-ft. deep ship channel from the Port of New Orleans directly to the Gulf of Mexico, outlined in our July issue, has now received formal endorsement by the Board of Commissioners of the Port of New Orleans, who propose to enlist the co-operation and assistance of local Associations in approaching the Governmental Authorities for the approval of the project and for the appropriation of the necessary funds in order to finance it.

New Pier at Seattle.

For some months past work has been in hand in connection with the construction of a new pier at Seattle, Wash., U.S.A., for the Seattle Port Commission, and it is now learned that the pier is nearing completion and that it will shortly be in commission. It has a length of 1,000-ft. and a width of 100-ft. The superstructure comprises two single-storey transit sheds, each 960-ft. long and 120-ft. roof span, fully equipped with the latest appliances for cargo-handling purposes.

Pilferage at Bristol Docks.

Commenting on a case at the Bristol Police Court in which two men were fined for theft at the docks, Mr. A. J. Harris, Chairman of the Bench, said: "We are alarmed to hear that it is the practice at the Avonmouth Docks to make collections to pay fines imposed in this court. We want to express our view that those who contribute to such funds are as bad as the thieves. This petty pilfering at the docks has been assumed alarming proportions and it must be stamped out. The time has arrived when we ought to deal with such cases in terms of imprisonment."

Santos to be Used as Bolivian Port.

The President of Brazil, Dr. Vargas, has given assurances that the Port of Santos will be available for use by the State of Bolivia, which is a land-locked country. If Paraguay agrees, Bolivia will also have access to the River Plate by way of the Paraguay River.

Retirement of Harbour Engineering Assistant.

Mr. Henry W. S. Collie, chief engineering assistant at Aberdeen Harbour, retired at the end of July after 51 years' service. He was due to retire in June, 1942, but his service was extended for a year.

The Institution of Structural Engineers.

At the annual general meeting in May, Major A. H. S. Waters, V.C., D.S.O., M.C., M.Inst.C.E., was elected President of the Institution of Structural Engineers for the session 1943-44. This is Major Waters' second term of office.

Glasgow Harbour Tunnel.

It is probable that the Glasgow Harbour Tunnel, which has been closed for some time for the purpose of examination of its condition, will not be re-opened to traffic as it is stated to be beyond repair.

Retirement of a Senior Surveyor at Lloyd's.

Mr. Ernest W. Blocksidge, a senior surveyor on the Chief Ship Surveyor's staff at Lloyd's Register of Shipping, is to retire during the month of August. Mr. Blocksidge is a well-known writer on subjects connected with ship's tonnage and life-saving at sea, and has been a contributor to the columns of this Journal.

Dry Dock Owners' and Repairers' Central Council.

At the recent annual meeting of the Dry Dock Owners' and Repairers' Central Council, held in Edinburgh, Mr. L. T. G. Soulsby, of Mountstuart Dry Docks, Ltd., Cardiff, and Mr. H. A. J. Silley, of R. & H. Green & Silley Weir, Ltd., London, were re-elected chairman and vice-chairman respectively.

Cardiff Dry Docks' Dividend.

The Directors of the Mountstuart Dry Docks, Cardiff, have declared a dividend for the year to March 31st last, at the rate of 6 per cent. per annum on the preferred ordinary shares and 6 per cent. per annum on the deferred ordinary shares, both less income tax (same as last year). The accounts of the company will not be ready for submission to shareholders until later in the year.

Proposed Air Base at Portsmouth.

The Lord Mayor of Portsmouth has told the City Council that when the Air Ministry deal with the question of Civil Aviation, very careful consideration will be given to the Langstone Harbour scheme at Portsmouth. The Docks and Air Port Committee reported that preliminary details of a plan for constructing an Empire Air Base at Langstone had been approved.

Canadian Dredging Firm's Finances.

Canadian Dredge and Dock Company, Limited, for the year ended December 31st, 1942, made a net profit of $109,415 which is equal to $1.15 on each common share outstanding. The company showed a net operating loss of $32,977 in the previous year. The operating profit for 1942 was $303,566 and other income brought revenue up to $329,800. Deductions included $125,000 for depreciation and $70,000 for income and excess profits taxes

Distinction for Port Official.

Included in the recent King's Birthday Honours List was the conferment of Membership of the Order of the British Empire (M.B.E.) on Mr. P. W. J. Martin, Personal Assistant to the General Manager of the Port of London Authority. From 1930 onwards Mr. Martin was personal clerk to the late Sir David Owen, then general manager, and in 1938 he became personal assistant to his successor, Sir Douglas Ritchie.

Quayside Cranes and other Cargo Handling Appliances at Ports

By J. DALZIEL, M.I.E.E.

Introduction

THIS article refers to quayside machinery in general and to cranes, and more especially to electrically-operated cranes, in particular. It is written mainly from the point of view of the purchasing and using engineer, and deals in a general way only, with constructional features which are chiefly the concern of the contractor building and supplying the crane.

The article also discusses the reasons for the adoption—nowadays practically universal—of electric operation, not only for cranes, but for the general machinery equipment of docks and harbours, though it is of course true that much old hydraulic machinery remains in effective service. As all the machines comprising the total equipment of a harbour, including, of course, the cranes, are in general supplied from a common power source and the nature of the demands of each affects the others, materially, a survey of the various principal types of machine concerned, together with an outline of their respective functions and characteristics affecting the form of power best suited to them, is thought likely to be useful.

Factors Affecting Cost of Power.

As regards the cost of power, current purchase tariffs are generally based on total consumption and on load factor; frequently, the terms are further affected by power factor. Load factor is a measure of the user of the supply, being the relation of the mean demand over a stipulated period, generally a month or a quarter, to the peak demand during that period. Its effect is to lower the price per unit the higher it is where, as is general, the tariff is so much per kilowatt of maximum demand plus so much per unit.

Power factor arises only with A.C. (alternate current) supplies (which means practically all bulk supplies), and is a measure of the effect of the self-induction of the apparatus in use in causing the current flow to lag behind that of the voltage producing it, thus requiring higher current for the same power, and loading up mains and generating plant with wattless or " idle " current. The power factor is the percentage relation of the actual watts in a circuit to the product of the volts by the actual amperes flowing, and in most cases where it enters into the tariff terms, the maximum demand is metered and charged on kilovolt-amperes and not kilowatts. In passing, it should be noted that capacity in a circuit has the opposite affect to induction, i.e., it causes the current wave to lead that of the voltage. Condensers are therefore sometimes installed to correct power factor and thus reduce the current and the peak demand charge; the same result is also attained by the use of over-excited synchronous motors and of other motors of special type over-corrected for power factor. The chief offenders in reducing power factor are lightly loaded induction motors.

That apart from the effect of increasing demand, every machine of an installation has an effect on every other and on the economics of the installation as a whole will thus be clear.

Factors Influencing Adoption of Electric Power

The main factors influencing the general adoption of electricity are its facility of application to the driving of individual motions, its high efficiency over a wide range of load, its wide availability, and its low cost. Bearing on the last-mentioned, the very fact of the great demand it has created for itself makes it possible to use, in its production and distribution, plant in its largest and most economical forms. Again, as has been already indicated, the position of the consumer in respect of his terms of purchase is, in general, the better the greater his user. Electricity, in fact, lends itself to centralisation and in the modern form of universal linking-up, to co-ordination of generation and therefore to low production cost, as well as to facility of distribution and supply, as no other form of power can do. These considerations dictate the general supersession and elimination of alternative forms of power distribution, e.g., hydraulic pressure water, unless in exceptional cases.

The discrepancy in costs for equal energy content is already so great indeed, that in the case of many hydraulic installations electric pumping—very generally with turbine pumps—has superseded steam with economy; this means hydraulic power per unit of energy commencing with a cost for current alone, some 50% in excess of electricity used direct.

In the writer's view, such a change-over should be accompanied by the conversion to direct electric operation of many of the appliances in extensive use and making a large demand for pressure water, as for example, outstandingly in the case of capstans. This would not, of course, apply to coal hoists and the like nor to cranes and other machines dealing regularly with approximately full load, but it might apply to busy cranes working on loads light as compared with the full rated load of the appliances. Such conversions should result, and in the writer's experience have resulted, in a large saving in the volume of pressure water to be pumped and in overall costs.

At most docks, even if electric operation has been utilised for all modern machinery, much of the older hydraulic machinery remains; at most coal-loading docks, as regards hoists in especial, there has been little if any change-over.

Driving Methods

Where cranes have to be portable over a wide range, they must necessarily be driven by steam, or internal combustion engine, so as to be self-contained; in neither case is there present the power capacity for rapid acceleration and high speed, such as is conferred by the over-load capacity of the machinery of the electric crane on the one hand, and its ability to draw heavily on the central power supply on the other; hydraulic machinery is likewise limited to the water intake capacity of its cylinders.

The steam crane is generally driven by a single engine operating through clutches; the internal combustion crane may be similarly arranged, but more often the engine drives an electric generator and the different motions are worked by individual motors, as in the case of an ordinary electric crane. These utilise the high starting torque features of electric motors generally and so use the capacity of the crane generator to the best advantage, but there is not the same power behind them as is the case where they are driven from a central power supply.

Electric cranes are almost invariably driven by individual motors for each drive, though in the case of older cranes and in some few other instances, a single motor has been used to drive two or more motions operating through clutches, as in the case of the steam cranes. Such drives are satisfactory enough where high speed and high duty are not required, and they could be very reliable. One such crane of the writer's acquaintance had been working satisfactorily for well over 30 years at the time when he lost connection with it. For the reasons given herein, the individual drive electric crane worked from a central source of supply is the best available means for the handling of cargo at a quayside.

Various Types of Cargo

The traffic which is, in general, handled by cranes of one form or another consists, in the main, of general cargo of considerably varying character, but there are, of course, at most ports, numerous specialised cargoes, some loose and some comprised of packages in large numbers of uniform character, arriving to be dealt with in bulk, for example, iron ore, pig iron, iron and steel bars, timber in its various grades, baled cotton, wool, tobacco, etc., fruit, meat and other foodstuffs, as well as coal, grain, etc. Some of these special cargoes lend themselves to handling by means other than by crane, for example, grain is generally loaded by gravity

Quayside Cranes at Ports—continued

and unloaded by elevators, mainly of the suction type; bananas and other fruit are in general handled by elevators and conveyors of a special character adapted to the traffic, etc.

The evolution of these latter is based on the ease of application to them of electric power. Suction elevators for grain can be driven by steam, gas or oil engine, and no doubt in some cases are so driven, but in the main, they are electrically operated. Both these classes of machine give a long hour steady load favourable to supply.

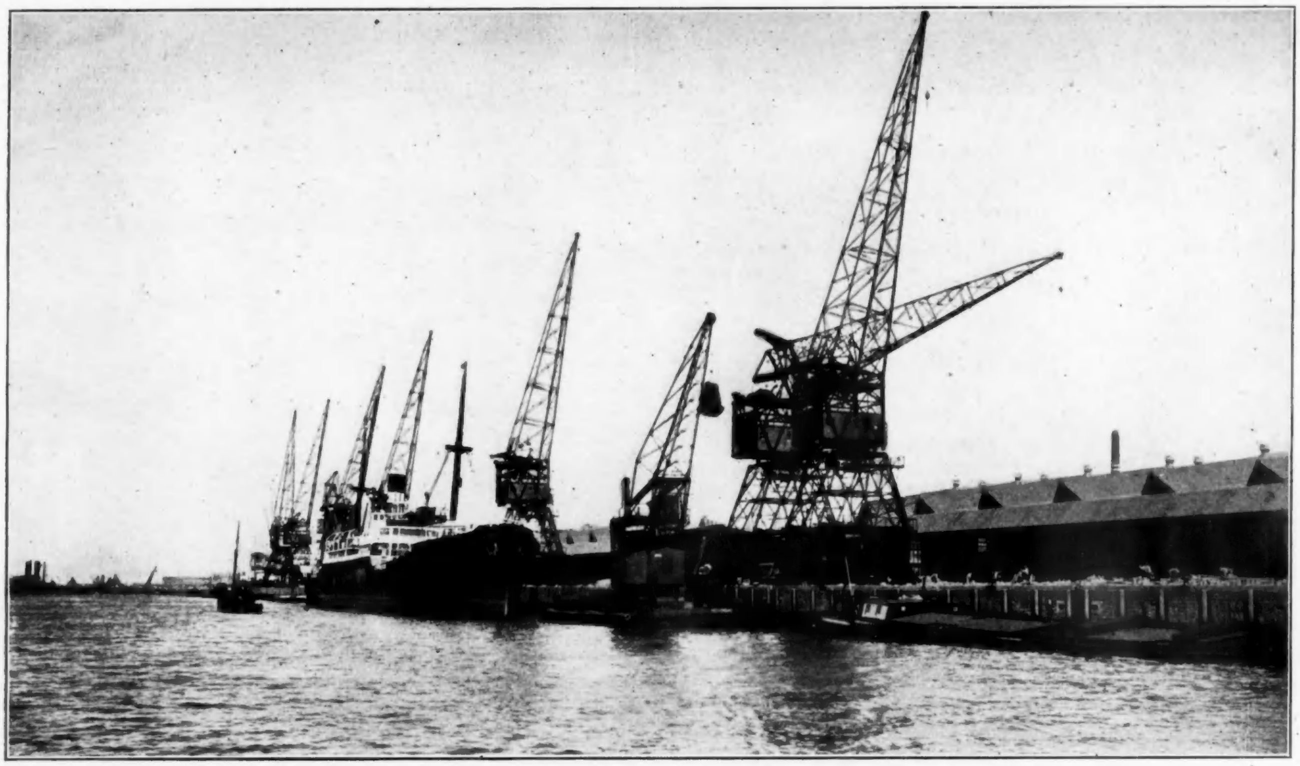


Fig. 1. Quay Cranes at the Port of Rotterdam (pre-war).

Coal-Handling Plant

Coal at some ports forms the bulk of the traffic of first grade importance and has in the past been mainly handled, as regards loading, by coal hoists and to a less extent by cranes.

For the operation of the heavy and long direct vertical lifts of the former, hydraulic power is definitely the most suitable form of power; for the latter, steam has been largely used in the past, but in modern cranes electricity is preferred and is extremely suitable. For coal shipment, however, belt conveyors are in the writer's view, preferable to both, being much more flexible and rapid in operation, especially in respect of bunkering; they also reduce manual trimming and lend themselves to the use of appliances as well as to the embodiment of features in their own design, for the reduction of breakage. Conveyors are well suited to electric operation and, in fact, would not be operable without it; their demand arises, in the main, from motors in continuous operation and their peak demands arise in general from a short lift only of the coal wagon, and its tipping into a ground level hopper. Compared with the peak demands of coal hoists or coaling cranes, those of coal conveyors are comparatively low and of short duration except in a few special cases where the wagons are lifted to some height before being tipped, mainly for reasons of economy in ground space.

A modern hoist lifting the wagon bodily to the required height, generally considerable, is required to do so fast enough to ensure fast shipment—generally up to 700 tons an hour at least—and that being so, power is demanded in heavy " gusts "—up to several hundred horse power—of short duration. Such " gusts " can be easily and adequately supplied without undue demands on the supply plant with hydraulic operation by drawing on the accumulators, but while there is no particular difficulty other than some complication in the driving plant in applying electric operation to a hoist of the usual hydraulic type, the load is a very unfavourable one from the supply point of view and to reduce its adverse effect on supply mains and other distribution apparatus and obviate objectionable fluctuations of voltage, requires the installation of storage in the form of a battery, or of inertia storage, such as that of a flywheel set of the Ilgner or other type. The latter is used in the only case in this country of which the writer is aware, of hoists of this type, capacity and speed, comparable with modern hydraulic hoists, being electrically driven. In the writer's view the best way to apply electric operation to a coal hoist is by the use of hydraulic operating gear worked from electric pumps.

Conveyors tip the wagons to empty them, as do coal hoists, and, in the case of side tippers, lift them bodily to do so, but as already indicated, in general lift them only to a height sufficient for tipping; consequently and as the long empty return stroke is also thereby avoided, they can use a much lower speed for equal or greater hourly capacity. This is the reason why, as above mentioned, the peak demands are lower and of shorter duration. The remaining motions, other than those of very occasional use for adjusting height and fore and aft and athwartship position of the point of delivery, are continuous and rotary rather than reciprocating in character and are therefore well suited to electric operation.

Up to the time of the outbreak of war, conveyors were being increasingly adopted in the North-eastern districts and to some extent in South Wales and, in fact, it is only in one coal district, namely, Scotland, that cranes have been recently installed or considered at all as compared with hoists or conveyors. They have, in fact, been superseded and abandoned in some districts.

In the Scottish area, though much slower and more cumbrous in operation and much less flexible in regard to point of delivery,

Quayside Cranes at Ports—continued

bunkering, etc., they are ostensibly preferred as causing less breakage of the coal. According to the writer's experience, which is considerable, this is based on an entirely theoretical and imaginary conception of the way in which the cranes are used and where conveyors have been installed, fitted with one of at least three types of anti-breaker, the preference is certainly not justified by actual results on the basis of any of the fairly numerous tests with which the writer has been associated.

Unloading of coal from the ship, which in this country is dealt with in large volume, principally at South Coast ports and in London, when mechanically performed, is done generally by grab working from some type of crane. Where grabs are not in use, unloading is generally effected by hand labour, the coal being shovelled into tubs in the hold and these when full being lifted out by crane and swung over to their delivery point which may be a hopper feeding a belt conveyor or an elevator. The tubs are generally top heavy when loaded so as to be self-emptying by upsetting themselves on the holding catch being knocked up out of engagement.

This being said, it will be necessary to leave the question of coal loading, excepting for what may arise in reference to coaling cranes. Grabbing cranes for unloading coal and for dealing with iron and other ores are, of course, also described.

Coaling plants and particularly conveyors and all their ramifications and arrangements for dealing rapidly with the bringing forward of full wagons, tipping these and getting rid of empties, carrying the coal to the ship at suitable height, weighing, trimming, bunkering, etc., avoidance of damage to wagons and also to the coal itself and saving of man power, would call for remarks and notes so extensive as to form a long article in themselves.

Various other Machines and their Load Characteristics.

Yet other forms of elevator are those—generally portable—used for loading passengers' luggage from the quayside to the ship's deck of passenger liners and *vice versa*. These also are practically dependent for their operation, portability, etc., on the ease of application and conveyance of electric power.

Other machines in use in docks are **Capstans.** Of these there are generally considerable numbers for operating rail traffic, and in some cases for hauling ships along the quay face. These are by far most economical in power when operated electrically, but are very prevalently hydraulic in the case of old installations still using hydraulic power. For them A.C. is the most suitable current; their load is not a favourable one.

Lock Gate Machinery.—This is mainly hydraulically operated. In the writer's view this is the most suitable form of power for these appliances and they are another type of machinery best operated electrically, when it is desired so to work them, through pumps and rams. This also is not a favourable load.

For impounding and other pumps, particularly of the centrifugal type, electric operation is outstandingly most suitable. This forms a long-hour load favourable to supply and suited to the use of synchronous or other motors embodying power factor correcting features.

Another development increasingly in vogue of recent years is the use of **power-driven barrows** or trucks. As originally developed, these were operated electrically by means of secondary batteries, but of recent years such trucks have been largely operated by small petrol engines; this has the advantage of avoiding the vehicle being set aside at intervals for charging the batteries, or alternatively saves the labour and time occupied in exchanging charged batteries for those that have been discharged in use, and re-charging these latter.

Apart from the quayside, there are in warehouses, cranes which may be of various types, but are in the main of the overhead traveller type; also conveyors or transporters, running on the under flange of "H" girders, forming a track for them, are in considerable use at some ports for conveyance between quayside and warehouse; these conveyors sometimes are arranged to run from the fixed "H" girder track on to a corresponding "H" girder carried on an overhead traveller in the warehouse.

Both travellers and transporters are obvious developments of the application of electric power without which they would not be possible in any convenient form. Other accessory machines are lifts and/or hoists, jigger hoists, etc. There are various other applications of power in and about docks, e.g., in work shops, etc., for all of which electricity is applicable and advantageous.

Obviously in the above list of machinery, while there are a number of types which can be and have been in the past, operated by means other than electric power, there are numerous new types owing their evolution to electric power and its convenience of application and operation, and more particularly to the facility with which individual electric motors can be applied to the various drives.

The conditions at docks have not shown themselves to be seriously detrimental to electric apparatus which as now constructed can withstand the effects of damp, salt air, etc., and even to some extent neglect of maintenance, though where an installation is properly cared for on systematic lines it will always repay the attention bestowed upon it.

First Electric Dockside Cranes

So far as the writer is aware, the first application of electric operation to the crane equipment of a complete dock quayside was that of the cranes at Rothesay Dock, Glasgow, belonging to the Clyde Trust, the cranes being supplied and constructed by Messrs. Stothert and Pitt. While this application was no doubt in a measure experimental, it was presumably based on an anticipated economy in operating costs over hydraulic cranes; the features recommending electricity in other directions had in these early days not yet made themselves fully apparent.

Hydraulic and Electric Comparisons

As already indicated, the cost of electricity, energy for energy, is much less than that of hydraulic pressure water; 1,000 gallons of pressure water at 750 lbs. per sq. in. is equivalent to $6\frac{1}{2}$ kw. hours and therefore to correspond with electricity at $\frac{3}{4}$d. per unit, the hydraulic cost must not exceed about 5d. per 1,000 gallons or about half the cost generally attained even in the case of pumping stations of very considerable capacity. According to the writer's experience, there is no public supply available at anything like the cost and as pointed out earlier when pressure water is electrically pumped, as it now frequently is, it of necessity commences with an excess cost over electricity directly used of from 50% to 100%.

Further, while neither the hydraulic nor the electric crane has any inherent service superiority over the other and both can be made to give, within reason, any desired speed of movement, with a full load efficiency of about the same in both cases, namely, about 70%, the electric crane permits of the application, without loss of efficiency, of starting power in much greater energy volume, and is therefore much more lively in acceleration up to full speed. In addition, while the electric crane maintains its efficiency throughout a wide range of loads, the hydraulic crane must have rams providing for any required overload and for meeting the requirements of acceleration and friction and must fill the cylinders behind these rams with the same amount of water for any lower load, including the empty hook, as for full and overloads.

The average load on a general cargo crane runs about 5 to 10 cwts. or say one-fifth of the usual rated load of a crane dealing mainly with general cargo. The electric crane will lift this with about quarter full load power against the full load demand of the hydraulic crane and, on the day's work, for load and empty hook lifting the energy consumption of the hydraulic will be about six times that of the electric crane.

For the other motions the respective consumptions are more alike, but hydraulic consumption overall may be put as three times electric for the same work on general cargo which means about six times in cost.

General Features of Quayside Cranes

The quayside cranes are, of course, the main cranes of the dock equipment. They may load into the ship from railway wagons and *vice versa* in unloading, deliver into these. In some cases they may, however, deliver on to a receiving deck, whence the load is trucked to the wagons and *vice versa*, this being more convenient where cargo has to be loaded into wagons of differing

Quayside Cranes at Ports—continued

destinations. Or the loads may be lifted from the receiving deck by another crane of say, the overhead traveller type, with an underhung jib or similar device which distributes and, if necessary stacks the goods for storage in an adjacent warehouse or shed. In some cases, the warehouse may be remote from the quayside and, in these cases, while the warehouse is served by an overhead traveller it and the quayside are inter-connected by transporters or conveyors of the type the track of which is formed of the bottom flange of an " H " iron.

As such transporters can run round curves of moderate radius and can also pass through points, the track may take a route to suit the features of the site and it may also be doubled at suitable points enabling the conveyors to pass each other.

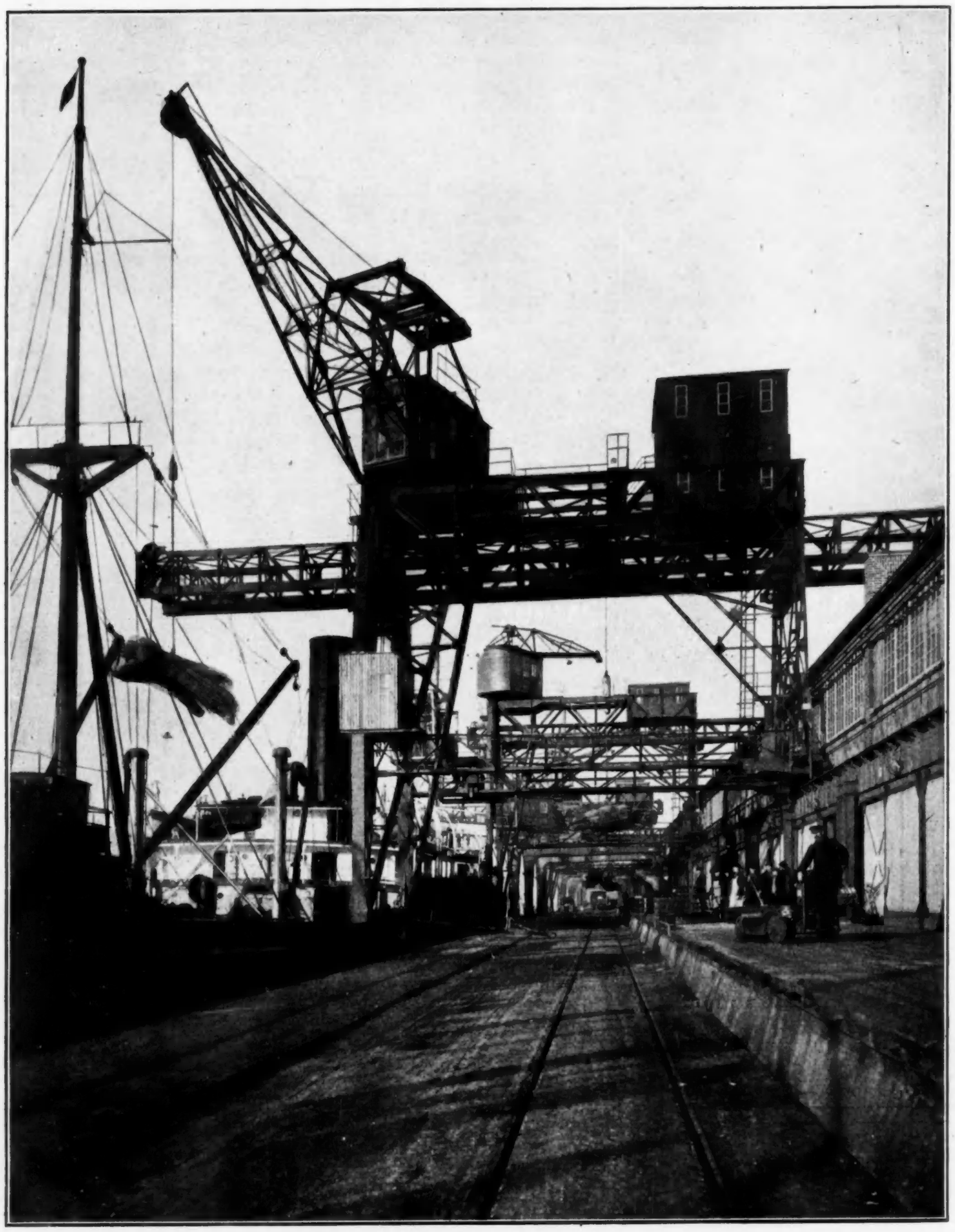


Fig. 2. Compound Quay Cranes at the Port of Hamburg (pre-war).

Several types of quay cranes are shown in the illustrations Figs. 1, 2 and 3 accompanying this article.

The layout of the quayside cranes must obviously fit the requirements of the site, as well as of the traffic operating department. Efficiency in respect of these latter requirements is the main consideration which must and ought to predominate within reason over all others, including engineering, first cost, maintenance and/or past practice.

In the view of the writer the proper standpoint for mutual discussion between those who are to use plant to be installed and those on whom it lies to specify and order it, is that of attaining the appliance that will be the most efficient tool for its specific purpose, without regard to other considerations, departmental or otherwise.

In arriving at a decision, however, the whole circumstances must be recognised. In some instances, where the appliance is to be used once or twice a day for a few exceptional loads, it may be that the crudest, cheapest and slowest appliance that will do the work is the proper machine to instal. This, however, is very unlikely to apply in the case of quayside cranes, as to which generally only the best of appliances, giving the fastest speed, the maximum facility of operation, the highest reliability and, lastly, the lowest energy consumption and maintenance costs, will be good enough. Perhaps more than in any other case the efficiency of the cranes is the governing factor in the speed of loading and unloading the ships and facilitating their quick turnround and of the efficiency, reliability and reputation of the Port.

It must not be overlooked that the very large and varied possibilities and applications of electric cranes and the preponderance of electric over hydraulic appliances generally have resulted in the former being developed and elaborated to the greater extent.

In considering cranes it must be had in mind they are, at best, machines of, roughly, only 50% movement efficiency, that is, for every movement made under load, a corresponding idle movement must take place. Every lift with load, for example, must have its counterpart in a return lift of the empty hook and it may be that for an appreciable proportion of the empty movement time the working staff are perforce standing by idle.

Quayside Cranes at Ports—continued

Incidentally, it may be remarked that could an elevator and conveyor be devised of portable type capable of being passed into the ship's hold and giving continuous movement in the direction of either loading or unloading and not requiring packages to be slung, it would appreciably reduce the time of dealing with cargo. The possibility of such a development was under investigation by the late Mr. Reid, one of the first Vice-Presidents of the L. M. & S. Rly., at the time of his death.

As things are, it would appear to be of importance to aim at reduction of empty movement time by speeding up as much as possible during these movements. This is, however, considerably affected by the characteristics of the different motors that may be applied according mainly to the type of current with which the cranes are supplied.

Advantages of Direct Current (D.C.) Apparatus

The ideal motor for crane purposes is the D.C. series motor; this has a characteristic such that it automatically speeds up on light loads owing to its torque varying roughly as the square of the current, i.e., as its current increases with load, its field strength likewise increases. Its torque does not increase exactly as current squared owing to the magnetic saturation of the iron of the field magnets limiting the increase of field strength to something less than proportionately to the increase of current; this varies with different motors according to whether the iron is cut down and worked at a high magnetic density or is generously proportioned and worked lightly.

The empty hook speed can, accordingly, with a motor characteristic suitably chosen, be up to three times, and quarter load speed up to nearly twice full load speed, and further speeding up can be attained by shunting the field by special control gear, if desired. The control gear, including its braking gear is also simple in design and construction and in operation.

The form of current generally supplied, is, however, almost universally 3-phase A.C. which in most cases, for the reasons which will shortly be set out, is much less suitable for crane purposes than D.C.

In view of the superiority of the D.C. crane, if the best results are to be aimed at, as already indicated they should be, D.C. current should be supplied for the cranes by conversion; this not only gives a superior crane, but one sufficiently more economical in maximum demand and current consumption to largely counterbalance the loss of 10% or so in conversion.

The greater simplicity and cheaper first cost of D.C. motors and their control gear as compared with A.C., the control gear of which is much more complicated and expensive than D.C., since there is more of it, because of its three wires in place of two and of the separate stator and rotor circuits, as well as because solenoids, etc., are of much less simple construction, will go far towards meeting the cost of converting apparatus. The provision of this in any case is a comparatively simple matter, as glass bulb rectifiers can meet all the requirements and require no attendance and very little maintenance, as well as taking up very little space.

Alternate Current (A.C.). Drive

Alternate current can, of course, be used direct for crane operation and with sufficient facility to make it unnecessary to consider any other alternative for cranes where the maximum of movement efficiency, more especially in speed of working on variable loads has little or no economic value, for example, on cranes uniformly working at or near full load, cranes for occasional use in dealing with special loads and the like.

That the three-phase motor lifts light loads and empty hook at practically the same rate as full load is however an outstanding defect for crane working. Even on a crane where full load prevails, such as, say, a grabbing crane, which as just stated can be suitably driven A.C., the slow empty hook speed is, at least, detrimental, and on a general cargo crane where the average load is a fraction only of full load, the resulting slowing down on light and empty hook loads is serious, more especially when it is borne in mind that the cranes set the time in most cases for the working staff.

Complementary to its constant speed characteristic, the torque of the A.C. crane motor, contrary to that of the D.C. machine which increases faster than current, varies only directly as the current. This gives it the further disadvantage that a high starting current is required and the consequent low starting efficiency and high resistance losses reflect back on maximum demand and are liable to increase the unit cost of current.

Logically, the full load rated lifting speed should be raised to improve the light load speed performance. This, however, involves motors of higher h.p., further loss of efficiency and still higher maximum demand, but it is a course that should be adopted in the interests of efficient traffic service, even if the higher speeds be not used at all on heavy loads.

Slip ring motors are the most suitable for A.C. crane working; the use of high resistance squirrel cage rotor type motors has been suggested, but, so far as the writer is aware, these have never been adopted for quayside cranes. Their use would simplify control gear (though not necessarily decreasing its maintenance), but at the expense of more jerky starting and they would multiply the starting current demand several times over.

Special A.C. Motors

Series motors of the single-phase traction type with transformer tapping variable voltage control, have speed torque characteristics that would make them eminently suitable for crane working and they have superior starting efficiency even to D.C. motors, but they are very expensive and have not been applied to crane work in this country, so far as the writer is aware; perhaps one reason for this is that no one has made a beginning with them. It would be very difficult with them to provide for a balanced load on the three phases of a 3-phase supply, and there would therefore be strong objections to them on the part of power supply engineers.

The 3-phase variable-speed commutator-type motor in its various forms is also better suited to crane operation than the slip-ring or squirrel-cage machine; its speed is widely variable up to a ratio of as much as 10:1, or more, generally by rotation of the brushes round the commutator. It has, however, the disadvantage that as available in this country in the form of the Schrage motor, it does not share the automatic variation of speed with load which is the outstanding feature of the characteristic of the series motor; for any one position of the brushes on the commutator, its speed is approximately constant. Thus, if the maximum speed is set at a high figure for light load or empty hook lifting, there is nothing inherent to the motor itself to prevent the attempt being made to lift heavy loads at this speed likewise. These motors have, however, been used on a number of cranes, generally abroad, with overload preventive devices providing against the aforesaid contingency by means external to the motor and embodied in the control gear. Three-phase motors with series characteristics have been developed but are not, as far as the writer is aware, available in this country; they, in general, require auxiliary apparatus which rather complicates them for crane use.

On very heavy cranes dealing with lifts of 40 to 50 tons or over, using A.C., it is general to motor generate by the Ward-Leonard or other system to variable voltage D.C. for the higher powered motors which are frequently rated as high as 200 h.p. or over.

In general, these D.C. motors are not series characteristic motors and therefore to this method the same applies as to non-speeding up on light loads as to the A.C. commutator motor; the fields of these motors are, in general, connected across the constant potential exciter supplying the field of the variable potential generator through an adjustable rheostat. The absence of the automatic speeding up feature on these very heavy cranes, doing specialised work is not of such consequence as in the case of general cargo cranes and may in fact be a safety factor. It also permits of braking being effected regeneratively and lowering being kept in control at constant pre-determinable speed if desired.

It would appear possible to apply grid-control rectifiers giving variable D.C. voltage to cranes of this type in replacement of the motor generators and, indeed, the writer sees no reason why this should not be a possible application to cranes of smaller capacity also; it awaits, however, a pioneer installation.

Features of Design and Operation

Turning now to general features of the design and layout of quayside cranes, it should be noted first that by far the pre-

Quayside Cranes at Ports—continued

dominating type is the jib crane having the jib with the lifting barrel, machinery and cab rotating (or slewing) round a locating centre post on a circular roller path. The jib in general is fitted with a luffing motion, that is, a motion whereby the load can be traversed in and out in line of the jib by the movement of the latter up or down in a vertical plane round the pivot pin at its bottom end.

The jib, machinery, driver's cabin, etc., are carried by an elevated undercarriage formed of, generally, two main girders running at right angles to the quay-face and tied together at either end and as requisite at intervals along their length by cross members, the whole forming a substantial structure on which the centre post and roller path are mounted, and which is elevated to the required height on legs at each corner. These legs are cross braced in the direction lengthwise of the quay and also in that across the quay where traffic has not to pass below; where it has, an opening clear of bracing and conforming with the railway structure gauge is left, the bracing being placed at a suitable height accordingly. Carriages of this type are termed portal; sometimes, however, the carriage is taken back to a carrying girder at a suitable height on the wall of a warehouse, there being then only the two front legs; such carriages are called semi-portal. In either case there may be provision below for one up to three of four sets of rail-tracks, the cross girders of the crane being, of course, stiffened up as necessary to correspond with the increase of span.

Where the crane embodies travelling motion, the wheels are mounted at the bottom of the legs or, in the semi-portal case, at the bottom of the front legs and below the carriage at the back; normally they will be four in number, one of which on each side, in the case of power travelling, is driven from a motor, centrally placed, through a cross-shaft and a vertical shaft down each of the appropriate legs and finally through bevel gear, or spur gear in the case of the back wheels of a semi-portal crane. Where the crane is non-portal, the horizontal cross-shaft is carried across at low level and spur gear used without any vertical shafting.

In the case of heavier cranes the total number of wheels and the number driven are increased accordingly. Normally the weight per wheel allowing for the weight imposed when the crane is slewed so as to put the weight of the jib and load directly over the wheel should not exceed about 30 tons, but where very heavy cranes are concerned, this may rise to 50 tons, in which case the wheels should be made with high tensile steel tyres on steel centres.

In general, the travelling gear is used only for positioning the crane relatively to the hatches preparatory to actual loading or unloading; it is not, as a rule, used regularly in the handling of loads for which it would be a clumsy and uneconomical motion, entailing as it does movement of the whole crane and its full weight.

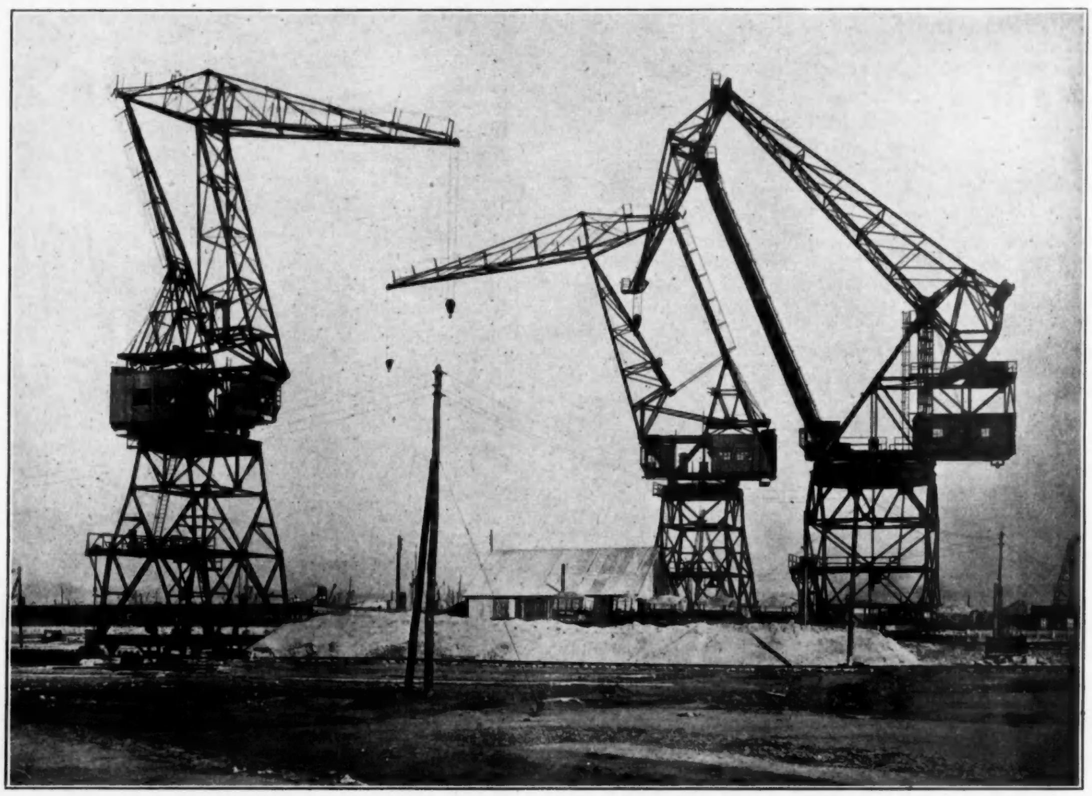


Fig. 3. Cranes at the Port of Le Havre (pre-war).

In addition to permitting the passage of traffic below it, the height of the carriage platform or gantry must be sufficient to give an ample height of lift above the ship's deck and structures, without any undue length or an unsuitably steep angle of the jib, and to give also a satisfactory view of the ship's hatches from the driver's cabin. It is sometimes necessary to give additional height in order to enable the tail of the crane, projecting beyond the quay-face, to clear ship's super-structures; this is bad practice; the tail race should always pass inside the quayface and allowance should also be made for the ship listing over towards the quay to some extent. In setting out the cranes, the engineer responsible for their main features of design should insist on the track layout and dimensions being such as to permit of the crane being of normal construction giving ample room for the machinery, etc., and for easy access thereto for maintainence and so forth.

In the case of a 5 or 6-ton crane having a single track portal, for example, the crane track rails should be of 15-ft. centres to give safe clearance for traffic and the tail-radius is roughly 12-ft.

The centre post should in such a case be at the centre of the gantry. The minimum distance from quayface to the nearest rail should therefore be 4-ft. 6-in. No less dimensions should be accepted and if it is desired to put down cranes on existing tracks

Quayside Cranes at Ports—continued

which do not conform thereto, it is better to insist on the alteration of the tracks than to impair permanently the efficiency of the cranes.

Motions

There are, in general, four motions of a jib crane of the prevalent type, namely, lift and lower, slew, luff and travel. Of these the first three will quite generally be in use for every load. It may be repeated here that the usual quayside crane capacity for general cargo quays is 3 to 5 tons.

Grabbing and coaling cranes have discharge and tipping barrels in addition to the lifting barrel and there are frequently, on heavy lift cranes, barrels for both heavy and lighter loads, to, in some instances, a total of three.

Lifting and Braking

Lifting should be done preferably on a single wire rope terminating in a hook and bob-weight, the latter being of small dimensions as to be just sufficient to run out the rope and empty hook under all circumstances; it is important to take up as little room in the hatches and have as little weight to move and swing about as possible. The rope is sometimes doubled up in a snatch block to halve the lifting speed and give double the lifting capacity, the jib and other parts of the crane affected being, of course, designed to carry the heavier load.

There are various objections to this arrangement, e.g., that with it, in general, the level luffing gear no longer acts, the large and heavy snatch block is an inconvenience in the hold, and attachment of the end of the rope to the jib head for doubling-up and *vice versa* is difficult if not dangerous, especially in stormy weather. It is better, therefore, where two lifting capacities are to be given that this be done on a single rope with change speed gear in the cab. The winding drum should take the whole length of the rope plus, say, two turns in a single layer; generally the drum is specially grooved for the rope, the end of which should be anchored to it.

The drum is generally driven by the lifting motor through single reduction gear on high speed cranes at least, but double reduction gear is, of course, permissible. It is, however, noisy and less easy to accommodate than single reduction; the latter with well-designed and well-cut gear can be used with a sufficient reduction ratio to allow the use of motors of reasonably high speed. Winding drums should be of a diameter at least 24 times the diameter of the rope to be used on them.

Braking methods will be discussed at some length later in this article, but it may be said here that mechanical brake drums are frequently fitted to the motor shaft which involves the brake power and the stresses thereof being transmitted through the gearing. The writer prefers the brakes to operate directly on the winding drum, thereby safeguarding any possible breakage of gear teeth and relieving the gear of stresses which may exceed those of normal lifting duty, though this, of course, necessarily involves the application of braking apparatus of considerably higher torque capacity owing to the slower peripheral speed available.

It cannot be overlooked, however, that with any of the electrical braking arrangements in use—these being described later—the braking stresses cannot but be transmitted through the motor shaft and through the gear.

It will be obvious that the less gear there is between the lifting rope and the brake the safer the working conditions, as it is quite possible to break even the best gearing by mishandling the crane, for example, by catching the coamings of the hatch in lifting, by putting the controller suddenly over to reverse or by similar action.

As regards speeds, these on 3 to 5-ton cranes generally run from 150 to 250-ft. per minute for lifting full load. The speeds of cranes of higher capacity are in general not reduced proportionately and the horse powers increase substantially accordingly.

As already indicated on heavy cranes requiring motors of 200 h.p. or more, special motors and types of control are generally introduced.

Particularly on comparatively short lifts, the adoption of unduly high speed tends to increase motor h.p. and add to the maintenance costs of control gear with no corresponding increase of efficiency in handling freight as the high speeds cannot be got into action sufficiently quickly or for sufficiently long a time to be fully effective. Grabbing cranes, however, are an exception being generally worked with fairly heavy lifts at speeds up to 250-ft. per minute or over.

Slewing

Slewing gear with steam or electricoperation can give continuous rotation in either direction. With hydraulic operation, it is worked by a cylinder and ram for each direction, or the equivalent, and therefore though the jib can be slewed through an arc exceeding 360°, rotation cannot continue indefinitely.

Slewing is generally operated by means of a motor-driven pinion on a vertical shaft which engages in a circular rack generally of about the same diameter as the roller path.

The roller path is generally formed as a complete loose or live ring with coned rollers working between correspondingly coned rings respectively on the carriage and on the underside of the cab. In some cases, especially in older cranes, it is formed of a small number of rollers respectively under the jib and opposite thereto, carried on spindles supported from the underside of the crane cab and working, of course, on a fixed coned roller path on the under-carriage.

The slewing motion should be fitted with a brake and is very generally also fitted with a friction clutch, which is intended to slip when stopping, and also to a less extent during acceleration. Such clutches are not altogether reliable in their setting and are generally not very accessible for setting, with the result that they are frequently tightened hard up and their purpose thereby defeated.

Slewing speed is generally about 2 revs. per minute, this in terms of feet per minute of course varies according to the radius of the crane. A general figure for slewing speed is about 400-ft. per minute.

Travelling

Travelling gear has been partly dealt with on a preceding page.

Where power travelling is fitted, it is in general of low power and for low speeds. High speed travelling along the ground is in any case objectionable along a quayface or for that matter in a goods yard (on cranes of Goliath type for example) on account of danger of collision with trucks, etc., and to staff. Moreover, to travel a crane as a whole and its entire weight bodily is a very clumsy and uneconomical movement, and its effects can be, or should be, capable of being more economically, simply, and effectively attained by luffing.

There is naturally a good deal of back lash between the driven wheels on the two sides of the crane, and in the case of very wide span cranes, the wheels on each side are sometimes driven each by their own motor; the two motors should be electrically interconnected to run at identical speeds; there are several methods of effecting this, e.g., with D.C., by coupling the armatures through slip rings. It is a feature more often required for comparatively fast travelling Goliath cranes in storage and similar yards than for quayside cranes, especially of jib type.

A brake, preferably of automatic application type, should be fitted to the travelling wheels to ensure prompt stoppage and to guard against movement in high winds; it should be capable of being pinned down.

Similarly a brake should be fitted to the traversing motion of cranes embodying such a motion.

(To be continued)

Obituary.

The death at the age of 56 has been announced of **Mr. Alfred Butler Huggins,** acting Secretary of the Port of London Authority, following an operation. Mr. Huggins entered the Authority's service in 1924 and subsequently became Rating Clerk. He was appointed Acting Secretary in 1941.

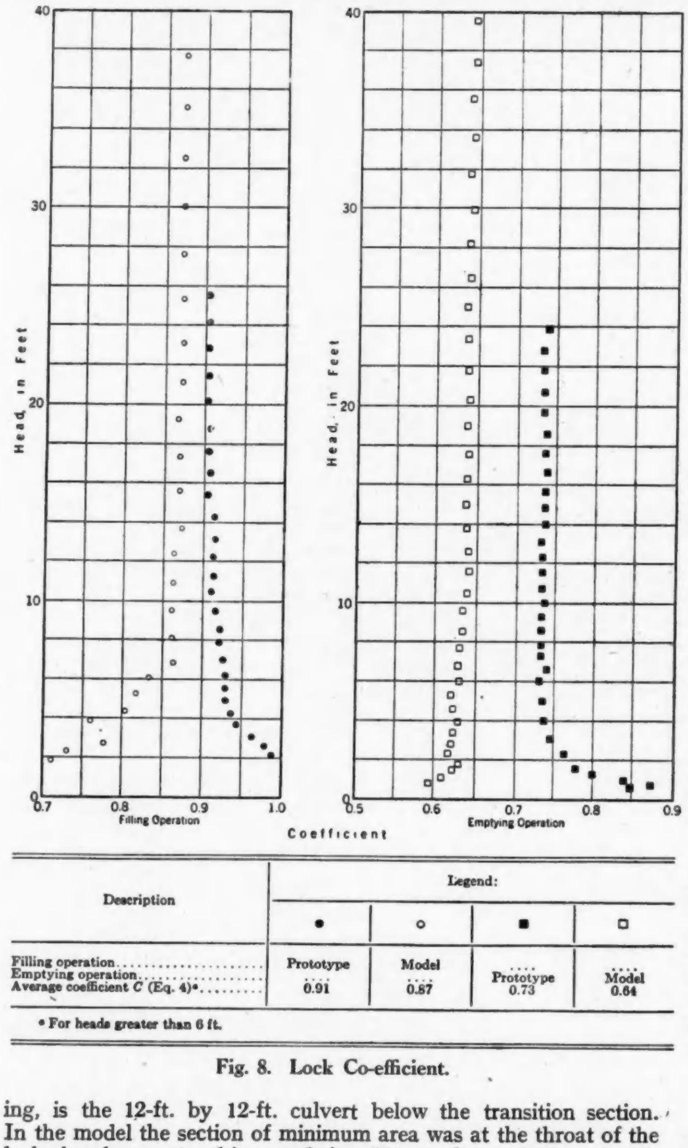
The death at Penzance was reported a short time back of **Captain J. L. Vivian Millett,** who was for three years a member of the Port of London Authority. In 1925, he offered himself for election as an independent candidate, was successful in spite of determined opposition by official electoral interests, and retained his seat till 1928. Capt. Millett, who was born in 1865, had the distinction of having served on the famous sailing ships, the *Tweed* and the *Cutty Sark*.

Model Prototype Conformity in Interesting Cases of Lock Construction

By MARTIN E. NELSON, M.Am.Soc.C.E., and JAMES J. HARTIGAN.

(Continued from page 69)

Lock Co-efficients.—The co-efficients for lock hydraulic systems presented in this paper were computed for the period after the valves were fully opened and were based on the minimum culvert area. In the prototype lock system the section having the least area through which the water passes, both in filling and emptying, is the 12-ft. by 12-ft. culvert below the transition section. In the model the section of minimum area was at the throat of the lock-chamber ports, this area being 250 sq. ft. as compared with the minimum culvert area of 288 sq. ft. The culvert area in the prototype was the same as in the model, but the cumulative port area at the minimum section was 292.8 sq. ft.



Description	Legend:			
	•	○	■	□
Filling operation	Prototype	Model		
Emptying operation			Prototype	Model
Average coefficient C (Eq. 4)*	0.91	0.87	0.73	0.64

* For heads greater than 6 ft.

Fig. 8. Lock Co-efficient.

The so-called lock co-efficient C_l which is a bulk co-efficient representing the efficiency of the lock, is equal to the ratio of the observed discharge to the theoretical discharge computed by the plain orifice equation using instantaneous heads:

$$C_l = \frac{v_l A_l}{A_c \sqrt{2gh}} \qquad \ldots\ldots\ldots\ldots(4)$$

In eq. 4: v_l = the lock-chamber rate of rise and fall; A_l = lock-chamber area; and A_c = cross-section area of two culverts. The filling and emptying co-efficients determined for the prototype and model locks are shown in Fig. 8 and Table 2.

The average co-efficient for filling the prototype lock based on the culvert area, which is the smallest section in the course of flow, was 0.91 as shown in the legend. In the model the co-efficient based on the culvert area was 0.87. However, the smallest area in the course of flow in the model was at the throat of the ports, and when the model co-efficient is correlated to the prototype value by applying the ratio of culvert to port area, 1.15, it is increased to 1.00, which is not in agreement with the prototype value. It would appear that the venturi type flow in the ports during filling makes a comparison of the lock co-efficients unsatisfactory because the divergence effect in the model and prototype was not the same.

The average co-efficients for the emptying operation, based on the least culvert or port area, are for the prototype 0.73 and for the model 0.64 × 1.15, or 0.74, which are in agreement within 2%. The flow through the lock-chamber ports during an emptying operation is not similar to that in a flaring tube, and the decrease in the efficiency of the model as indicated by the lock co-efficient is directly proportional to the reduction in the area of the controlling section.

In the orifice equation, used in computing lock-chamber discharge,

$$Q = C A \sqrt{2gh} \qquad \ldots\ldots\ldots\ldots(5)$$

the head, h, for filling, is the upper pool elevation minus the lock-chamber elevation, and, for emptying, the lock-chamber elevation minus the lower pool elevation. This head is simply the hydrostatic head and is not the complete effective head acting on the column of water in the culverts. Considering the filling operation, the lock-chamber water surface does not stop when it reaches upper pool elevation but rises above it. Therefore, at the instant when the lock is full the effective head is not zero but has some positive value. When the dynamic head factor is included in the equation for discharge the resulting co-officients for decreasing heads become smaller instead of larger. Thus, in the prototype tests, as shown in Fig. 8, the ascending value of the co-efficient as the head decreases can be attributed to the fact that the effective head was not used in the computation, whereas in the model tests the decrease in the co-efficients for low heads may indicate that the hydrostatic head is more nearly equal to the effective head in the model than in the prototype.

Co-efficients based on the effective head (that is, static plus dynamic) and co-efficients based on static head alone have the same adverse characteristic of not being entirely constant throughout the lock operation. On the other hand, the effective head is not so easily measured as the static head. In view of the difficulties of establishing the exact value of the effective head and of the questionable advantage, in the comparison of model and prototype, of the co-efficient thus obtained over that based on the static head, all lock co-efficients presented in this paper are based on the static head alone.

Wheeler Lock—Comparison of Prototype and Model Tests

Lock Stage Tests.—Stages measured with respect to time during filling operations in the Wheeler model and prototype lock chambers are shown in Fig. 9. The points which define the curves are averages of two stage measurements, one near each end of the lock chamber. Typical sections through the lock-chamber ports are shown in Fig. 10

In the prototype, it was necessary to make the tests with existing elevations of 553.9 for the upper pool and 503.9 for the lower pool; tests had been made previously in the model with elevations of 556.0 and 506.0, respectively. In each case the head was 50-ft., but the pool levels used in the model were 2.1-ft. higher than in

*Reproduced from the Minutes of the American Society of Civil Engineers, October, 1942.

Model Prototype Conformity in Interesting Cases of Lock Construction—*continued*

TABLE 2—Comparison of Model and Prototype

Item No.	Structure	Lift (ft)	Time (Min)		Rate[a] (ft per min)	Slope[b] (ft per 100 ft)	Area (Sq Ft)				Coefficients		Distribution of Flow (Percentages)[c]						Scale ratio	Item No.
			Valve	Operation			Lock chamber	Culvert	Port: Throat end	Port: Lock-chamber end	Lock hydraulic system	Transition section	Intake Ports: Upstream half	Intake Ports: Downstream half	Lock-Chamber Ports: Upstream half	Lock-Chamber Ports: Downstream half	Discharge Ports: Upstream half	Discharge Ports: Downstream half		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	
	(a) Filling Operation																			
	1st Lock																			
1	Model	61	2.0	10.17	11.1	0.148	74,250	288	250	640	0.87	0.93	45.5	54.5	40.4	59.6	....	....	1	1
2	Prototype (right)	55	5.07	12.00	8.9	0.062	74,250	288	292.8	640	0.91	0.92	47.0	53.0	17.3	82.7	....	....	30	2
3	Prototype (left)		6.62																	3
	2nd Lock																			
4	Model	50	1.00	7.20	12.6	0.148	24,300	160	240	240	0.62	....	....	....	31.3	68.7	....	....	1	4
5	Prototype	50	1.07	7.08	12.4	0.273	24,300	160	240	240	0.61	....	....	....	32.4	67.6	....	....	20	5
	3d Lock																			
6	Model	39	1.00	6.15	12.5	0.117	24,300	128	102.8	211.8	0.88	0.93	45.5	54.5	47.0[d] 46.5	53.0[d] 53.5	....	....	1	6
7	Prototype	39	1.12	5.50	12.7	0.118	24,300	128	102.8	280.8	0.95	0.95	46.0	54.0	40.8	59.2	....	....	20	7
	(b) Emptying Operation																			
	1st Lock																			
8	Model	61	2.0	13.48	8.6	0.045	74,250	288	250	640	0.64	....	....	....	42.1	57.9	44.4	55.6	1	8
9	Prototype (right)	55	3.97	13.30	7.3	0.030	74,250	288	292.8	640	0.73	....	....	....	40.5	59.5	44.4	55.6	30	9
10	Prototype (left)		5.12																	10
	2d Lock																			
11	Model	50	1.00	8.03	11.7	0.059	24,300	160	240	240	0.56	....	....	....	30.2	69.8	....	....	1	11
12	Prototype	50	1.07	7.37	11.8	0.106	24,300	160	240	240	0.58	....	....	....	35.0	65.0	....	....	20	12
	3d Lock																			
13	Model	39	1.00	7.60	9.3	0.029	24.300	128	102.8	211.8	0.63	....	....	....	44.3	55.7	44.4	55.6	1	13
14	Prototype	39	1.12	7.60	8.8	0.052	24,300	128	102.8	280.8	0.63	....	....	....	46.5	53.5	43.6	56.4	20	14

[a] Maximum rate of rise or fall. [b] Maximum water surface slope. [c] Distribution based on equal number of ports upstream and downstream. [d] Model test at Norris Laboratory.

the prototype. In Fig. 9 the filling curve of the model is shown as observed and also adjusted to agree with the lower pool elevation of the prototype. The prototype lock filled in 7 min. 5 sec., whereas the model filled in 7 min. 12 sec. Maximum rates of rise were 12.4 and 12.6-ft. per min., and the slopes of the rate of rise curves were 1.90 and 1.94-ft. per min^2, respectively.

The emptying curve of the model was similarly observed and adjusted to agree with the upper pool elevation of the prototype. Emptying time in the prototype was 7 min. 22 sec., and in the model was 8 min. 2 sec. Maximum rates of fall of the water surface in the chambers were 11.8 and 11.7-ft. per min., respectively,

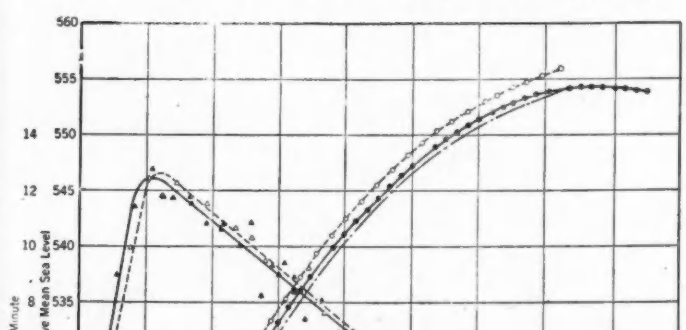


Fig. 9. Filling Characteristics.

and corresponding slopes of the rate of fall curves were 1.9 and 1.6-ft. per min^2.

The valve opening periods were nearly identical in the prototype and model, and the crests of the water surface change curves occurred at about the same time in the two structures. In the filling tests the model was slightly more efficient than the prototype, whereas in the emptying tests the reverse was true.

Velocity in Lock-Chamber Ports.—Distribution of flow in the lock-chamber ports for the left or river wall of the prototype and for the right wall of the model is shown in Fig. 11 (a) for the filling operation. The curves for the model were based on velocity tests with steady flow through the system, whereas the curves for the prototype were based on velocity measurements made during filling operations. The distribution of flow observed in the lock-chamber ports of the model is in good agreement with that of the prototype (see Table 2A). Inflow into the lock through the upstream five ports in the prototype was 32.4% of the total, and in the model 31.3%. The corresponding values for the downstream five ports were 67.6% and 68.7% respectively.

A good agreement is also noted in the distributions of discharge in the lock-chamber ports in emptying operations in one model and prototype locks which are shown in Fig. 11 (b).

Lock Co-efficients.—Filling and emptying co-efficients for one of the lock hydraulic system of the prototype and model are shown in Fig. 12. These co-efficients are based on observed discharges computed from the average rate-of-rise and rate-of-fall curves and on theoretical discharge computed from stage records (see Eq. 4). The average filling co-efficients for heads above 5-ft. are 0.61 and 0.62 for the prototype and model, respectively. Corresponding emptying co-efficients are 0.58 and 0.56. The lock co-efficient varies as the square root of the slope of the rate-of-rise and rate-of-fall curves. For that part of the filling operation for which co-efficients were computed, the model had the steeper rate-of-rise curve and the larger filling co-efficient, and the prototype had the steeper rate-of-fall curve and the larger emptying co-efficient.

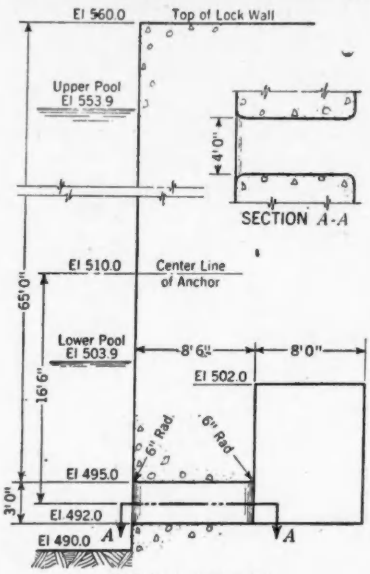
As in one lock, the pattern of the co-efficients of another indicated that there was less difference between the static and effective heads in the model than in the prototype.

Guntersville Lock—Comparison of Prototype and Model Tests

Intake Ports.—In the model tests on one lock it was found that the distribution of flow through the intake ports was fairly uniform and that it was affected only slightly by variations in the head. The intakes used in one model were also used in another

Model Prototype Conformity in Interesting Cases of Lock Construction—continued

model, and no further tests were made in the latter model to determine the distribution of flow through intake ports. In prototype tests of flow distribution at one lock it was found that the distribution of flow in the four ports on one side of the intake section varied from 20.5% to 28% and that the pattern of flow distribution was similar to that for the intake ports of another lock.



SECTIONAL ELEVATION

Fig. 10. Sections through Centre Line of Lock-Chamber (10 Ports in each Wall).

Transition Section.—The prototype and model transition sections are correlated by using the dimensionless co-efficient of discharge because corresponding dimensions of the culvert at which pressure measurements were taken were not similar. Co-efficients for the prototype and model transition section meter—0.95 and 0.93 respectively—are in good agreement.

Lock Stage Tests.—Stages with respect to time in the lock chambers (see Fig. 2) during filling operations in the model and prototype are shown in Fig. 13. The time required to fill the lock chamber with a 39.2-ft. head in the prototype (5 min. 30 sec.), was 39 sec., or about 11%, less than the time required to fill the lock chamber in the model. The rate-of-rise curves indicate that the water surface rose faster in the prototype than in the model during the time the valves were opening. It is believed that this difference is due largely to a personal factor introduced in the manual operation of the valves in the model. After the valves are open the rate-of-rise curves are in better agreement, having slopes of 2.77 and 2.57-ft. per $min.^2$ for prototype and model respectively. The maximum rates of rise were 12.7 and 12.5-ft. per min. in the prototype and model, respectively.

Emptying curves are shown in Fig. 14. The same period of time, 7 min. 36 sec., was required to empty the model and prototype lock chambers with a head of 39.0-ft., and the emptying curves were practically identical. Maximum rates of fall in the prototype and model were 8.8 and 9.3-ft. per min., respectively, and corresponding slopes of the descending rate-of-fall curves were 1.22 and 1.27-ft. per min^2.

TABLE 2A—Distribution of Flow, Lock-Chamber Ports (River Wall) (See Fig. 11)

Description	Average of Three Heads[b]			Average of Six Heads[b]						Average of Two Heads[d]	
	◆	▲	▼	■	▲	●	◀	▶	▼	□	○
Head, in feet	48	45	40	35	30	24	20	15	10	35	2[illegible]
Discharge,[a] in Cubic Feet per Second:											
(a) Filling operation	..	..	2,430	2,280	2,110	1,920	1,750	1,540	1,260	2,370	1,960
(b) Emptying operation	..	..	2,390	2,240	2,040	1,810	1,690	1,460[c]	1,180	2,130	1,760

[a] Discharge refers to flow into, and out of, lock chamber through ports in river wall. [b] Prototype. [c] 16-ft head. [d] Model.

Lock-Chamber Ports.—The distribution of discharge in the lock-chamber ports in filling operations on the prototype, on the Iowa City model, and on a model of the lock tested in the TVA Hydraulic Laboratory at Norris, Tenn., are shown in Fig. 15.

Velocities measured in the lock-chamber ports of the models with steady flow are shown in the distribution of flow curves as percentages of the total flow. Velocities measured in the lock-chamber ports of the prototype lock during filling operations were plotted against time, and from these graphs the port velocity distribution for a given static head was obtained, using the time interval at which the given static head occurred.

The distribution of flow during the filling operation was better in the models than in the prototype. Percentages of total flow

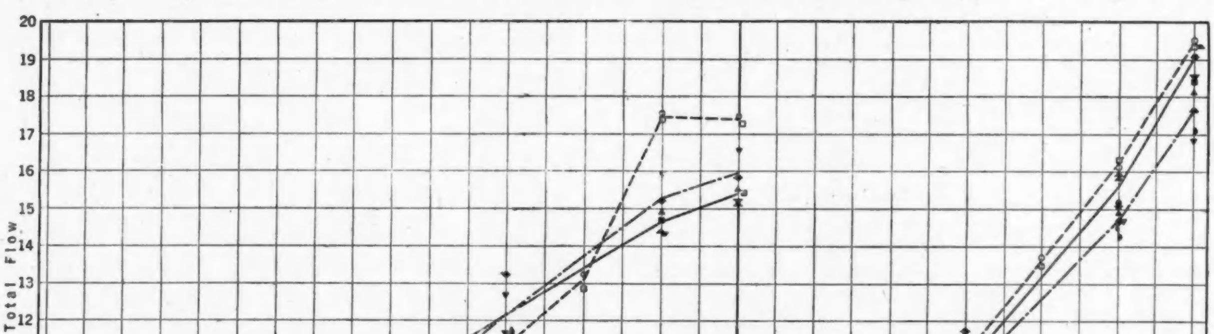
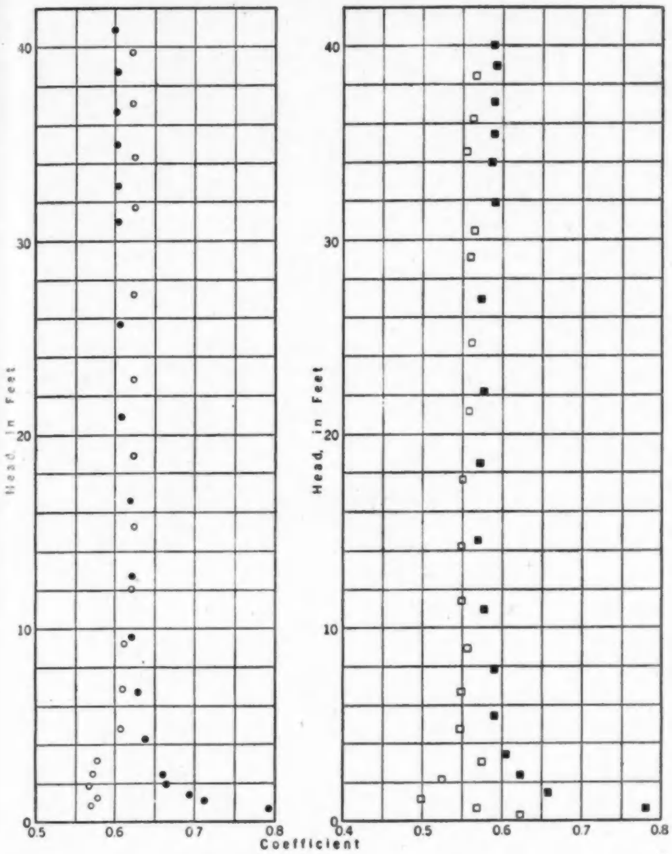


Fig. 11. Distribution of Flow, Lock-Chamber Ports (River Wall) (See Table 2A).

Model Prototype Conformity in Interesting Cases of Lock Construction—continued

carried by the seven ports in the upstream half of the chamber and by the seven ports in the downstream half of the chamber are: For one model (average of four heads), 47% and 53%; for another model (25-ft. head), 46.5% and 53.5%; and for the prototype (average of six heads), 40.8% and 59.2%. Patterns of flow distribution in the two models are very similar, and they agree more nearly with that of the prototype at a 35-ft. head than with the average prototype distribution after the valves are open.



Description	●	○	■	□
Filling operation	Prototype	Model	....	....
Emptying operation	....	....	Prototype	Model
Average coefficient*	0.61	0.62	0.58	0.56

* For heads greater than 5 ft.

Fig. 12. Lock Co-efficient.

The distribution of flow in the lock-chamber ports during the emptying operation in the model and prototype was in better agreement than the distribution during filling. Percentages of total flow carried by the seven ports in the upstream half, and in the downstream half of the chamber are, for one model (25-ft. head), 44.3% and 55.7%, and for the prototype, 46.5% and 53.5%. The models had the more even distribution during the filling operation, and the prototype during the emptying operation.

Discharge Ports.—Only preliminary tests were made on the distribution of flow in the discharge ports of one of the models. The discharge sections of one model were used also in another model, and since the preliminary tests agree with similar data from one of the models, no further tests were considered necessary.

From prototype port velocity tests at one lock, the distribution of flow in the sixteen discharge ports of the land wall were computed for seven heads ranging from 5 to 35-ft. Distribution of flow among the sixteen discharge ports remained approximately the same for the seven different heads, and the culvert flow carried by the eight upstream and eight downstream ports was 43.6% and 56.4%, respectively, based on the average distribution for the seven heads.

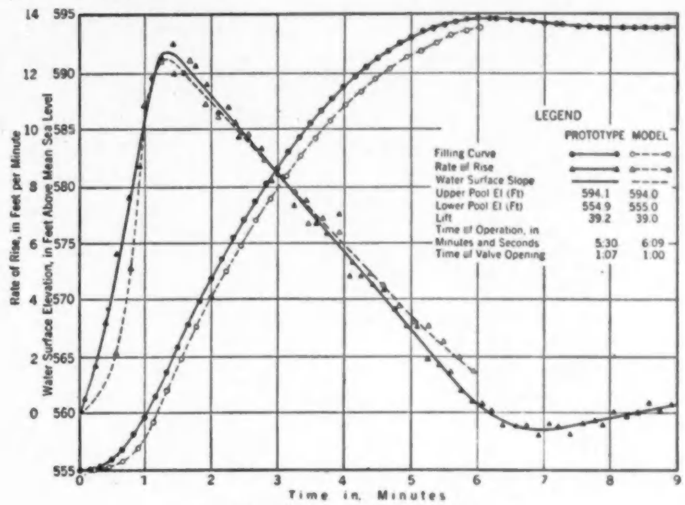


Fig. 13. Filling Characteristics.

Lock Co-efficients.—Average co-efficients for the lock hydraulic systems in the prototype and model, for heads greater than 5-ft., are:

Observations on:		Filling	Emptying
Prototype	...	0.95	0.63
Model ...	...	0.88	0.63

For the emptying operation the co-efficients are in good agreement, having the same average value for prototype and model, but for the filling operation the prototype co-efficient average 8% higher than those for the model.

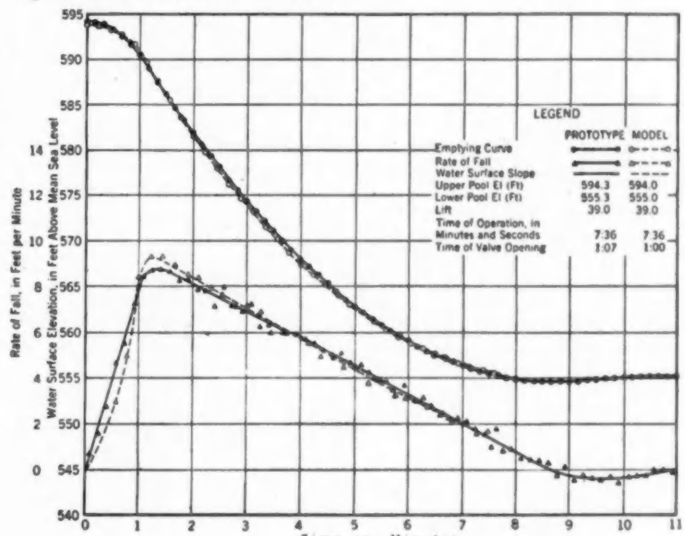


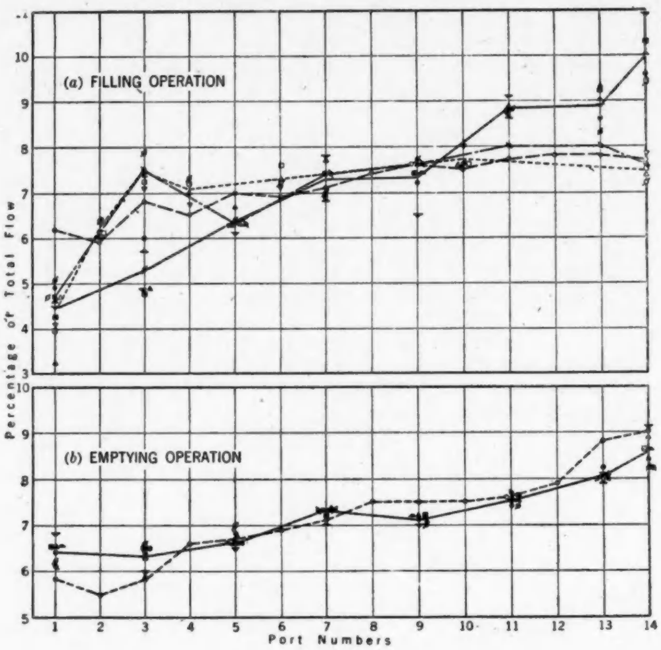
Fig. 14. Emptying Characteristics.

The prototype ports and the model ports for which data are presented in this paper have the same dimensions at the throat, but the prototype ports are larger at the lock-chamber end. Consequently, the divergence angle for the prototype, 11° 44′, is larger than that for the model port, 7° 50′, and the ports are not geometrically similar. This greater divergence angle is undoubtedly a factor contributing toward the higher co-efficients and faster rate of filling observed in the prototype.

Model Prototype Conformity in Interesting Cases of Lock Construction—continued

Although the area of the culverts was used in computing co-efficients for the lock hydraulic system, the minimum area in the prototype and in the model is the cumulative area at the throats of the lock-chamber ports. If, instead of the culvert, the minimum port area was used, the average co-efficient for emptying would be 0.78. For emptying one lock the average co-efficients based on least port or culvert area were 0.73 and 0.74 for prototype and model, respectively.

The co-efficients for a prototype lock based on static head gradually increase as the head decreases, and for the model they gradually decrease as the head decreases, until just before the end of the lock operation where values of the co-efficient increase sharply.



Description	Average of Six and Seven Heads[c]							One Head[d]	Average of Four Heads[d]			
	◆	●̸	●	⌓	■	▲	▼	○	ø	△	□	▽
Head, in feet	35[b]	30	25	20	15	10	5	25	33	25	17	7
Discharge,[a] in Cubic Feet per Second:												
(a) Filling operation	..	2,590	2,410	2,180	1,890	1,550	1,120	2,260	2,380	2,060	1,690	1,130
(b) Emptying operation	..	1,740	1,600	1,430	1,240	1,020	730	1,640	....	....	....	....

[a] Discharge refers to the flow into the lock chamber through the ports in the land wall. [b] The curve for the 35-ft head is plotted as a separate line in Fig. 34(*a*), the remaining six in this group being averaged. In Fig. 34(*b*), all seven are averaged. [c] Prototype. [d] Model.

Fig. 15. Distribution of Flow, Lock-Chamber Ports (Land Wall).

Summary and Conclusion

In Table 2 the results of model and prototype studies of three locks are summarised. It includes operation data and areas of critical sections of the lock hydraulic systems.

Tests on one lock offered the best opportunity for comparing model and prototype performance because the corresponding structures were geometrically similar and lock operation data were in agreement. Moreover, it will be noted that this lock had the most consistent agreement between model and prototype of the three locks tested, the only material difference in the performance of the corresponding structures being in the longitudinal slope of the water surface for which readings in the prototype lock were larger than in the model.

For model and prototype locks of another there was agreement in lock operation data, and the two structures were geometrically similar except at the lock end of the lock-chamber ports. A more efficient filling operation was observed in the prototype than in the model, the former having the greater divergence angle in the lock-chamber ports. Furthermore, during the filling operation, the less efficient model had the more even distribution of flow in the lock-chamber ports. It is of interest to note the performance of Guntersville model and prototype locks during the emptying operation. There was agreement in operation time, lock co-efficient, and the distribution of flow in the lock-chamber ports irrespective of the difference in lock-chamber port divergence angles. The throat of the lock-chamber port, for which the cumulative area was the minimum in the system, appeared to be effective as the control section of the system during the emptying operation.

There was less agreement in the performance of one model and prototype locks because, in addition to dissimilarity in the throat area of the lock-chamber ports, lift and valve time in the two structures were not in agreement. However, the performance of this model and prototype during the emptying operation, similar to that of other locks, showed agreement in the lock co-efficients based on the minimum areas in the respective systems and in the distribution of flow in the lock-chamber ports.

When geometric similarity does not exist in the important elements of two hydraulic structures it is not expected that their operations should conform to the basic laws of similitude. However, where geometric similarity did obtain, and where analogous functions could be correlated by means of the basic laws, this study substantiates the theory upon which the use of hydraulic models is founded and, it is believed, tends to justify the confidence engineers have placed upon this method of analysing difficult problems in design and operation within the past few years.

Acknowledgments

Col. R. G. Powell, then division engineer, Ohio River Division, Cincinnati, Ohio, sponsored the project and authorised the tests on the prototype locks in December, 1937. The tests were supervised by personnel of the U.S. Engineer Sub-Office, Iowa City, under the direction of the district engineer, U.S. Engineer Office, St. Paul, Minn.

The prototype lock tests were conducted by Marvin J. Webster, Assoc.M.Am.Soc.C.E., of the Iowa City Sub-Office, with the assistance of personnel from the District Engineer Offices in whose areas the respective locks are located. Some of the material presented in this paper has been drawn from a report on the project prepared by Mr. Webster for which acknowledgment is made. Permission to use the data obtained in the prototype lock tests is acknowledged to Col. J. W. Moreland, M.Am.Soc.C.E., district engineer of St. Paul.

(To be continued)

Government Policy in regard to Docks and Ports.

In the House of Commons on July 7th, **Mr. W. J. Brown,** the member for Rugby, asked the Parliamentary Secretary to the Ministry of Transport when he contemplated being able to make a statement on the post-war policy of his department in respect of docks and ports.

Mr. P. Noel Baker replied: Lord Leathers is actively considering the many complex problems involved in the post-war organisation of transport and of the docks and ports, but he has not yet reached the stage at which he can submit definite proposals to his colleagues in the Government.

Mr. Brown continued his enquiry as follows: In view of the fact that decisions on these two points are a necessary preliminary to decisions in a wide number of other fields, can the Minister give an indication of when he is likely to be able to make a statement?

Mr. Noel Baker: I am afraid I could not mention a date, but I should like to assure him the Minister is fully alive to the importance of the matter, and that a great deal of preparatory work is being done. The Minister is very busy operating the transport system for the war effort.

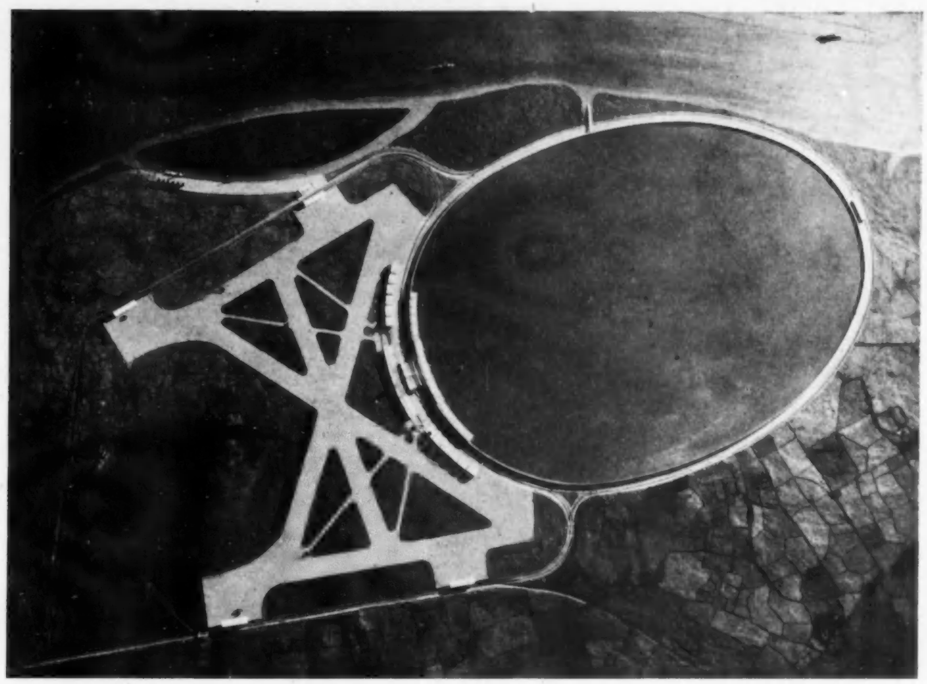
Mr. E. Shinwell (Seaham): Are the plans being prepared in consultation with the Minister Without Portfolio or in isolation?

Mr. Noel Baker: There are, of course, consultations.

Mr. Shinwell: What is the function of the Minister Without Portfolio on these matters?

Mr. Noel Baker: I say we are in consultation.

Master Plan for Sea-Air Port for London



The London Sea-Air Port project as viewed from the air. From a model of the scheme.

The illustration on this page, reproduced by permission from the July issue of the *P.L.A. Monthly*, shows an air port for the Port of London, as designed by Mr. F. G. Miles, who is managing director of a large aircraft construction company and one of the best known figures in the British aviation world. Messrs. Guy Morgan and Partners were associated, as architects, with Mr. Miles in the preparation of the scheme and they jointly acknowledge the technical assistance which they received from Messrs. Philips and Powis and Messrs. Short Bros.

According to Mr. Miles, " the airport has been planned as a base for both land and seaplanes. The difficulties of providing a safe landing for the latter conveniently sited in close proximity to London have hitherto been a barrier to any such enterprise. The final scheme as envisaged and here illustrated could be divided into stages, the first of which would be the construction of three runways only and a small nucleus of buildings, sea planes making use of the river to begin with. The proposition, therefore, need not be very heavy financially at first, but is capable of growing to full development as the need arises.

" The site is level, bounded on the north and west by the river, and on the south by slightly rising ground. An existing system of dykes facilitates the draining of the entire area. The directions of the contours and river allows of the symmetrical planning of the air port on an axis roughly north-east, south-west, i.e., on the line of the prevailing wind.

" A 10-minute, 24-hour service is contemplated, which would give approximately 8 million passengers carried per year, allowing for 150 per plane. Allowance should also be made for freight."

Mastership of Trinity House.

H.R.H. the Duke of Gloucester has been re-elected Master of the Trinity House at the Annual Court of the Corporation and Captain Sir Arthur Morrell was re-elected Deputy-Master.

Development of Turkish Ports.

As previously announced, a contract has been signed between the Turkish Government and the United Kingdom Commercial Corporation for the carrying out of the development of works at the Port of Alexandretta, renamed Iskanderun and Mersin. The work has been commenced and is making satisfactory progress.

Civic Visit to P.L.A.

The Lord Mayor of London accompanied by the Sheriffs paid an informal visit on July 26th to the Head Office of the Port of London Authority and had luncheon with the chairman and members.

Higher Goods Handling Rates at Liverpool.

The Minister of War Transport has sanctioned an application by the Mersey Docks and Harbour Board to increase the harbour rates for handling goods from 15 per cent. to 50 per cent., with effect from July 2nd. Mr. Hugh L. Roxburgh, chairman of the Finance Committee, recalls that the rate was raised to 15 per cent. in 1941, and states that the increase was necessary in view of the increasing expenditure consequent on the war effort.

Santos Docks Company Report.

The annual report for 1942 of the Santos Docks Company, states that gross revenue declined by 20 per cent. on the 1941 figure owing to the reduction of 25 per cent. in the tonnage of merchandise passing through the port, which, coupled with the increase in the cost of materials essential to the maintenance of the port services, raised the proportion of working expenses to total revenue to 80 per cent. from 69 per cent. for 1941. Gross revenue totalled Cr$62,410,000 (against Cr$78,156,000 for 1941) and working expenses Cr$49,979,000 (Cr$53,964,000).

Peruvian Port Activity.

The Peruvian Government proposes to create a holding Corporation to develop projects now under consideration, including the new Chimbote harbour works and other undertakings in the Santa River and the Chimbote Bay areas.

San Francisco Harbour Commission.

The recently appointed new president of the Board of State Harbour Commissioners of San Francisco is Mr. J. Ward Mailliard, formerly president of the San Francisco Chamber of Commerce. The other two members are Messrs. Thomas Coakley and W. G. Welt.

Institute of Transport—Northern Ireland Section.

At a meeting of members of the Institute in Northern Ireland held in Belfast on June 28th, it was decided to constitute a Northern Ireland section of the Institute. The first Chairman will be Mr. Michael J. Watkins, C.B.E., General Manager and Secretary of the Belfast Harbour Board.

New Lighthouse at Port of Coatzacoalcos.

A new lighthouse is in course of construction at the Mexican Port of Coatzacoalcos or Puerto Mexico in the province of Vera Cruz. It is situated on the eastern side of the river in a direct line with the eastern breakwater, the end of which is 2,116 metres distant. The lighthouse is a round edifice, built of white stone at an approximate height above sea level of 50.07 metres. The height of the tower to the base of the light will be 11.77 metres and to the centre of the light 13.57 metres. According to the present plans of the Marine Department, the eastern breakwater will be extended 40 metres. It is proposed to use the old oscillating light at Coatzacoalcos unless a new one is supplied by the Marine Department. The present light, which is on the western side of the river is only about 26-ft. high, so the new light will have a greater range.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